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September 15, 1988

Energy Research Abstracts

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ENERGY RESEARCH ABSTRACTS

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The Department of Energy's Scientific and Technical Information Program (STIP) is carried out at many levels within the Department and by its contractor organizations. The Office of Scientific and Technical Information (OSTI) in Oak Ridge, Tennessee, provides direction and leadership for STIP and serves as DOE's national center for scientific and technical information management and dissemination. Both DOE-originated information and worldwide literature regarding advances in subjects of interest to DOE researchers are collected, processed, and disseminated through an energy information system maintained by OSTI. The major data bases in this system are available within the United States through commercial on-line systems and to those outside the United States through formal governmental exchange agreements. The current-year records for the major data bases, plus a number of specialized data bases are available to DOE offices and contractors through OSTI's Integrated Technical Information System (ITIS). ITIS also serves as a gateway to other government and commercial systems and provides information merging for customized information products. To manage DOE's information resources effectively, DOE's Scientific and Technical Information Program is one of continual development and evaluation of new information products, systems, and technologies.

88-00414

ABOUT *ENERGY RESEARCH ABSTRACTS*

Energy Research Abstracts (ERA) provides abstracting and indexing coverage of all scientific and technical reports, journal articles, conference papers and proceedings, books, patents, theses, and monographs originated by the U. S. Department of Energy, its laboratories, energy centers and contractors. *ERA* also covers other energy information prepared *in report form* by federal and state government organizations, foreign governments, and domestic and foreign universities and research organizations. **The user should remain aware that *ERA* coverage of non-report literature is limited to that generated by Department of Energy activity.**

ERA is comprehensive in its subject scope, encompassing the DOE's research, development, demonstration, and technological programs resulting from its broad charter for energy sources, supplies, safety, environmental impacts, and regulation.

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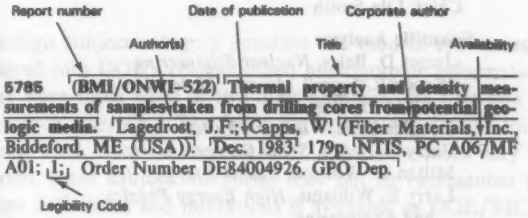
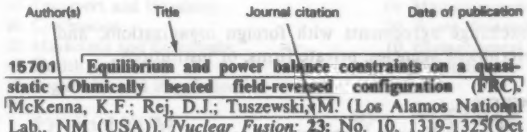
The principal elements of abstract entries for a typical research and development report and a typical technical journal article are illustrated below.



5785 (BMI/ONWI-522) Thermal property and density measurements of samples taken from drilling cores from potential geologic media. Lagedrost, J.F.; Capps, W. (Fiber Materials, Inc., Biddeford, ME (USA)). Dec. 1983. 179p. NTIS, PC A06/MF A01; L; Order Number DE84004926. GPO Dep.

Density, steady-state conductivity, enthalpy, specific heat, heat capacity, thermal diffusivity and linear thermal expansion were measured on 59 materials from core drill samples of several geologic media, including rock salt, basalt, and other associated rocks from 7 potential sites for nuclear waste isolation. The measurements were conducted from or near to room temperature up to 500°C, or to lower temperatures if limited by specimen cracking or fracturing. Ample documentation establishes the reliability of the property measurement methods and the accuracy of the results.



15701 Equilibrium and power balance constraints on a quasi-static Ohmically heated field-reversed configuration (FRC). McKenna, K.F.; Rej, D.J.; Tuszewski, M. (Los Alamos National Lab., NM (USA)). *Nuclear Fusion;* **23**: No. 10, 1319-1325 (Oct 1983).

Zero-dimensional power balance calculations are performed for a quasi-static, purely Ohmically heated field-reversed configuration. Without compression, the constraint imposed by radial pressure balance limits the power input. Estimates of the energy loss from impurity line radiation as well as from classical and anomalous transport are given. Effects of cold puff gas injection are also investigated.

INDEXES TO *ENERGY RESEARCH ABSTRACTS*

Five indexes are provided for approaching the contents of each issue of *Energy Research Abstracts (ERA).* Each index is preceded by an introduction that details the organization of the index and the principles by which it was compiled. The reader is referred to these introductions for information not found in the index examples that follow.

• Corporate Author Index

Technical report literature is indexed using the name of the organization or institution responsible for the issuance of the report.

5785 (BMI/ONWI-522) Thermal property and density measurements of samples taken from drilling cores from potential geologic media. Lagedrost, J.F.; Capps, W. **(Fiber Materials, Inc., Biddeford, ME (USA)).** Dec. 1983. 179p. NTIS Order Number DE84004926. GPO Dep.

is indexed as:

Fiber Materials, Inc., Biddeford, ME (USA)

• Personal Author Index

Each author's name is indexed in the form appearing on the document abstracted, with the exception that given names are reduced to initials:

Capps, W., *See* Lagedrost, J. F.
Lagedrost, J.F., Thermal property and density measurements of samples taken from drilling cores from potential geologic media, 9:5785 (R;US)
McKenna, K.F., Equilibrium and power balance constraints on a quasi-static Ohmically heated field-reversed configuration (FRC), 9:15701 (J;US)
Rej, D.J., *See* McKenna, K.F.
Tuszewski, M., *See* McKenna, K.F.

• Subject Index

The subject index consisting of entries naming specific materials, objects, and processes is arranged alphabetically. Document titles, informative phrases, or both specific to these entries are arranged alphabetically under the entries.

SALT DEPOSITS
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Thermal property and density measurements of samples taken from drilling cores from potential geologic media, 9:5785 (R;US)
REVERSED-FIELD PINCH
Energy Balance
Equilibrium and power balance constraints on a quasi-static Ohmically heated field-reversed configuration (FRC), 9:15701 (J;AT)

• Contract Number Index

DOE technical report literature is indexed using contract numbers. This index contains the contract number with corresponding abstract and report numbers.

AC06-76RL01830	**Fiber Materials, Inc., Biddeford, ME (USA)**	
	9:5785	BMI/ONWI-522

• Report Number Index

Technical report literature is also indexed using report numbers. This index includes information on where individual reports may be obtained. Patents and conference papers are indexed here as a matter of convenience. When a report is supplied under an Order Number, that number is included in the availability statement. An Order number–report number correlation is included for convenience.

BMI/ONWI-522	9:5785	NTIS, PC A09/MF A01. Order Number DE84004926, Distribution Category MN-70

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IEA Biomass Conversion Service
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IEA Coal Research
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Bethesda, MD

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Commack, NY

Communication concerning the editorial policy and content of *Energy Research Abstracts* should be addressed to the Editor, *Energy Research Abstracts,* Office of Scientific and Technical Information, P. O. Box 62, Oak Ridge, TN 37831.

SUBJECT CONTENTS (NUMERICAL LISTING)

Six-digit subject category numbers are used in the storage, retrieval, and manipulation of bibliographic information entered into DOE's computerized bibliographic information system. The six-digit category numbers are utilized as if they were three pairs of two-digit numbers, the first two pairs being used to arrange the abstract content of *Energy Research Abstracts*. The following listing includes the totality of the 40 first-level and 289 second-level subject categories used. Because each issue of *ERA* announces only those documents becoming available during a semimonthly period, some subject categories may not be represented in every issue. The complete subject category scheme with scope definitions and limitations is available as DOE/TIC-4584-R6 from NTIS for $9.50.

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ENERGY RESEARCH ABSTRACTS

01 COAL AND COAL PRODUCTS

39046 **(PB—88-194725/XAB) Bulletin of the National Research Institute for Pollution and Resources, Vol. 17, No. 2, November 1987.** (National Research Inst. for Pollution and Resources, Yatabe, Ibaraki (Japan)). 1987. 62p. NTIS, PC E04/MF A01.

Text in Japanese with English abstracts. See also PB—88-194717; Portions of this document are not fully legible.

Contents include: Hydrotreating of SRC filtrate using a fixed-bed flow reactor; Storage stability and the structure of the asphaltene of Thai shale oil (in English); Extraction of cobalt from hydrochloric acid solution by TOMAC in various low polar organic solvents; Characteristics of the formation of combustible gases in the gasification of wood pellets; Calibration method of hot-film anemometer at low velocity in small rotating basin; and Investigations of certain indices of seam proneness to sudden coal and gas outburst using cuttings (in English).

0103 Preparation

REFER ALSO TO CITATION(S) 39091, 39097, 39111

39047 **(CRANZ-TP—28) Open screw blender/homogeniser.** (Coal Research Association of New Zealand, Wellington). Feb 1985. 13p. Coal Research Association of New Zealand, Wellington.

A simple concept of blending/homogenising equipment with some application in New Zealand coal mines, and its operating principle, are described. The basic factors controlling its performance are explained in a simple mathematical treatment. A pilot-scale homogeniser with a capacity of about a quarter of a tonne has been constructed and operated as a means of confirming the theoretical performance. The application of this homogenising equipment in commercial operation is discussed. 6 figs.

39048 **(CRANZ-TP—32) Hot briquetting of sub-bituminous coal investigations with British coal.** (Coal Research Association of New Zealand, Wellington). Jun 1987. 12p. Coal Research Association of New Zealand, Wellington.

Techniques for the hot briquetting of sub-bituminous coal in New Zealand have some features in common with hot briquetting in Britain, but there are essential points of difference. Accurate assessment of the capital cost of a commercial installation and of the economics of hot briquetting as conceived for the New Zealand scene, is required. An equally important issue determining the profitability of commercial hot briquetting, is the annual rate for capital charges that would have to be applied in such commercial operation. British Coal could provide valuable advice in assessing the economics and the capital cost of commercial plant producing 10 tonnes per hour of smokeless briquettes, in the following unit processes: preparation of -10 +100 mesh coal; drying in fluidised bed; heating (without carbonising) to 380 degrees C; final heating and transfer of the coal to a cyclone above the press; briquetting with a hot roll press; cooling of briquettes. 1 ref., 2 figs.

39049 **(DOE/PETC/TR—88/3) Validation of image analysis and sample pellet preparation methods for estimating pyrite particle size distribution in crushed coals.** Irdi, G.A.; Rohar, P.C. (USDOE Pittsburgh Energy Technology Center, PA). May 1988. 16p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88010319/JAW.

During the development of an automated image analysis technique for measuring particle size distribution of pyrite (including maracasite) in crushed coals, several validation tests were conducted to establish confidence in the capability of the Zeiss IBAS image analysis system to accurately measure coal pyrite particle size. These tests, which included comparisons of IBAS-generated data to data obtained manually and by scanning electron microscopic analysis, showed that the IBAS could be used reliably to perform such analyses. Polished pellet sample homegeneity was also tested and no apparent problems were found. The data from pyrite particle size distribution analyses will be used in combination with pyrite particle degree of liberation data to develop a prediction method for pyritic sulfur reduction potential. 6 refs., 2 figs., 7 tabs.

39050 **(EPRI-CS—5713) Reducing electricity generation costs by improving coal quality: Proceedings.** (Electric Power Research Inst., Palo Alto, CA (USA); Writing Consultants Associated, Pittsburgh, PA (USA)). May 1988. 459p. (CONF-8611249—). Unlimited audience, publicly available. Research Reports Center, Box 50490, Palo Alto, CA 94303;1. Order Number TI88010316/JAW.

From Reducing electricity generation costs by improving coal quality; Indiana, PA, USA (5 Nov 1986).

The costs of generating electricity at a coal-fired power plant are significantly influenced by the characteristics of the coal that feeds the plant. Upgrading coal quality or assuring a consistent-quality coal can improve plant performance, increase boiler capacity, and raise plant availability. Sixteen papers presented at an EPRI seminar, "Reducing Electricity Generation Costs by Improving Coal Quality," address how to determine which coal to burn to produce the lowest busbar costs. These papers include case histories of utilities that have switched to higher-quality coal. They also describe computer models to assess coal quality effects and estimate coal cleaning costs. In addition, they examine various methods to predict how a given coal will perform in a particular boiler, and how coal quality can reduce emission control costs. This unique gathering of coal quality information was presented by speakers from US utilities, the Electric Power Research Institute, and the electric power industry. The seminar, sponsored by EPRI's Coal Quality Development Center, formerly the Coal Cleaning Test Facility, was held in November 1986. It drew approximately 80 representatives from US utilities, coal companies, and engineering firms.

39051 **(UCRL—97505) Granular flow: Particle-dynamics simulations of steady flow.** Walton, O.R.; Braun, R.L. (Lawrence Livermore National Lab., CA (USA)). 1987. Contract W-7405-ENG-48. 14p. (CONF-8709155—2). NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88011342/JAW.

From AR and TD solids transport contractors review meeting; Pittsburgh, PA, USA (17 Sep 1987).

New research tools in the form of two- and three-dimensional discrete-particle computer models that calculate the motion of each individual grain in assemblies of hundreds of particles in steady shearing flows with either periodic or real boundaries have been developed and are being utilized to study granular flow behavior. The particle interaction models reproduce experimentally measured recoil trajectories for colliding frictional particles, including rotation effects. The steady shearing flow models agree with laboratory measurements where such data are available and they agree with theories when comparable approximations are made in the model (such as assuming frictionless and nearly elastic particles). Calculational studies with these models have shown that stresses generally vary as the square of the shear rate and the square of the particle radii and depend strongly on inelasticity and void volume and less strongly, but still significantly, on friction coefficient. Less sensitive are dependences on particle stiffness, shear-to-normal stiffness ratio and details of the transition to full sliding

during frictional collisions. Laboratory measurements of the flow of glass beads cascading down through an array of horizontal cylindrical rods correlate well with gravity flow calculations of inelastic, frictional spheres falling through a similar rod array. Less elastic particles are found to cascade through the array faster than nearly elastic particles. Likewise, smaller particles are found to flow faster than large ones. Plans for extensions of the model capabilities, new boundaries, parameter studies and evaluation of new approaches for including the effects of interstitial fluids are discussed. 10 refs., 5 figs.

39052 **Effect of test variables on the erosion-corrosion of chromium steel.** Levy, A.V.; Man, Y.F. Houston, TX; National Assoc. of Corrosion Engineers (1987). 20p. (CONF-870314—). National Assoc. of Corrosion Engineers, P.O. Box 218340, Houston, TX 77218.

From Corrosion '87; San Francisco, CA, USA (9 Mar 1987).

There are several different, potentially erosive particles in the operating environments of coal conversion and utilization equipment. They include: coal, char, ash, various minerals and the corrosion scales which form and spall off the surfaces of the equipment. Each type of particle has a different erosivity at different conditions. The purpose of this study was to determine the effect of particle variable son the elevated temperature erosion-corrosion of 9Cr1Mo steel. It was determined that angular shaped particles remove oxide scale as it forms and directly erode the base metal at fast rates. Rounded particles permit a continuous, somewhat protective oxide scale to form on the metal surface which is eroded to much slower rates.

0104 Processing

REFER ALSO TO CITATION(S) 39050, 39082, 39086, 39109, 39109, 39121, 39123, 39228, 39443, 40605, 41309

39053 **(AD-A—192052/9/XAB) Evaluation of coal-derived EDS (Exxon Donor Solvent) mid-distillate. Interim report, October 1982-December 1984.** Bowden, J.N.; Present, D.L.; Yost, D.M. (Southwest Research Inst., San Antonio, TX (USA). Belvoir Fuels and Lubricants Research Facility). Dec 1986. 31p. (BFLRF—227). NTIS, PC A03/MF A01.

A cooperative demonstration program between industry and the Department of Energy yielded a sizable quantity of coal-derived, mid-distillate fuel producted by the Exxon Donor Solvent (EDS) process. Eighty-three 55-gallon drums of this product were made available to the Belvoir Fuels and Lubricants Research Facility at Southwest Research Institute for evaluation through the U.S. Army Belvoir Research, Development and Engineering Center, Ft. Belvoir, VA. The EDS mid-distillate was characterized in the laboratory for chemical and physical properties, and evaluated in a medium-speed diesel engine. Due to the low cetane number, toxicity, poor storage/thermal stability, and incompatibility with elastomers, this fuel was not evaluated as received in the normal operation of diesel engines. A 69/31 blend of the EDS mid-distillate and a petroleum-derived diesel fuel was used with relative success in a medium-speed diesel engine. A similar blend evaluated in single-cylinder diesel engine burned less efficiently than the petroleum fuel.

39054 **(BCU/CE—021987) Hot gas cleanup of gasification products.** Watkinson, A.P.; Cheng, G.; Quan, R. (British Columbia Univ., Vancouver (Canada). Dept. of Chemical Engineering). Feb 1987. 70p. (MICROLOG—88-01562). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1. $0.34 CAN per page, $3.40 minimum; MF $10 CAN.

A study has been made of particle cleanup from gases produced in an atmospheric pressure coal gasifier. Three devices were explored - a conventional cyclone, a vortex pocket cyclone of the Cardiff design and a granular bed filter of coarse particles operated in upflow. Typical solids loadings leaving the gasifier reached 0.3 kg solids/kg gas (300,000 ppM) when solids were recirculated to the bed from the primary cyclone. These solids were separated in a hot primary cyclone at inlet velocities of about 17 m/s to give an exit stream of about 2500 ppM. Particles recovered from the primary cyclone were about 65% carbon with the balance ash. The vortex pocket cyclone was operated at a very high inlet velocity of about 120 m/s and lower inlet loadings of 30,000 to 100,000 ppM with which outlet concentrations averaged 360 ppM over nine experiments. Eight tests were done with a granular bed filter downstream of the vortex pocket cyclone. The bed was about 0.25 m deep and packed with collector particles 2.2 mm in diameter. Inlet loadings were about 350 to 650 ppM. The low efficiency values (15-57%) are in the range calculated from literature models for the given conditions with particles below 2 μm in size. Particles collected were composed largely of ash, and contained about 15% carbon. Collection efficiencies are critically dependent on particle size in the range of interest. Scanning electron microscopy was found to be useful in interpretation of size distribution data for the fine particulates being measured by different techniques. Photomicrographs are presented of solid samples collected. Results in terms of inlet and outlet solids loadings were in reasonable agreement with the few studies available in the literature for coal gasification systems. 23 refs., 16 figs., 19 tabs.

39055 **(DOE/LC/10442—2545) Underground coal gasification: Development of theory, laboratory experimentation, interpretation, and correlation with the Hanna field tests: Final report.** Gunn, R.D.; Krantz, W.B. (Wyoming Univ., Laramie (USA). Dept. of Chemical Engineering). Mar 1987. Contract AS20-80LC10442. 136p. NTIS, PC A07/MF A01;1; GPO Dep. Order Number DE88001043/JAW.

The following report is a description of a 7 year effort to develop a theoretical understanding of the underground coal gasification process. The approach used is one of the mathematical model development from known chemical and principles, simplification of the models to isolate important effects, and through validation of models to isolate important effects, and through validation of models with laboratory experiments and field test data. Chapter I contains only introductory material. Chapter II describes the development of two models for reverse combustion: a combustion model and a linearized model for combustion front instability. Both models are required for realistic field predictions. Chapter III contains a discussion of a successful forward gasification model. Chapter IV discusses the spalling-enhanced-drying model is applicable to prediction of cavity growth and subsidence. Chapter VI decribes the correct use of energy and material balances for the analysis of UCG field test data. Chapter VII shows how laboratory experiments were used to validate the models for reverse combustion and forward gasification. It is also shown that laboratory combustion tube experiments can be used to simulate gas compositions expected from field tests. Finally, Chapter VII presents results from a comprehensive economic analysis of UCG involving 1296 separate cases. 37 refs., 49 figs., 12 tabs.

39056 **(DOE/MC/21050—2579) ASPEN simulation of environmental control processes: Task 2, Topical report.** Noblett, J.G. Jr.; Lowell, P.S.; Dweck, J.S.; Wilde, K.A. (Lowell (P.S.) and Co., Inc., Austin, TX (USA); Dweck (J.S.), Consultant, Inc., Denver, CO (USA)). Jan 1988. Contract AC21-84MC21050. 214p. NTIS, PC A10/MF A01;1; GPO Dep. Order Number DE88001084/JAW.

Accomplishments of Task 2 of this project are presented. Task 2 has resulted in the development and implementation of three new unit operations in the computer program ASPEN. The first is a multi-phase flash algorithm. The second is a new, sophisticated venturi model, and the third is a solid/liquid separator (clarifier/thickener) model. The flash algorithm considers one organic liquid, one aqueous liquid, one vapor, and any number of precipitated solid phases. However, the algorithm only includes temperature and vapor fraction specified options. We recommend that the new flash algorithm be used in updating previous simulations conducted for systems containing electrolytes. One possibility would be upgrading portions of the Great Plains Gasification Project Simulations made with ASPEN. The new ASPEN venturi model is a sophisticated one with simultaneous calculation of heat, mass, and momentum transfer. The new ASPEN solid/liquid separator model can perform thickening and/or clarification calculations in eithert the design or simulation modes.

39057 (DOE/MC/21386—2574) Fixation of alkali and trace metals in high temperature co-current entrained flow gasifiers and combustors: Final report. Wendt, J.O.L.; Peterson, T.W.; Shadman, F. (Arizona Univ., Tucson (USA). Dept. of Chemical Engineering). Oct 1987. Contract AC21-84MC21386. 416p. NTIS, PC A18/MF A01;1; GPO Dep. Order Number DE88001076/JAW.

The purpose of this research was to determine the effects of programmed process temperature profiles and coal/additive mixtures on the alkali and trace metal content of both supermicron fly ash particulate matter and submicron aerosols formed during the high temperature entrained flow gasification and combustion of pulverized coal. The research is based on the idea that control of temperature and temperature quench rate can favorably influence the fraction of volatile trace and alkali metals condensing on larger fly ash particles, and the additional surface area and surface properties provided by additives such as kaolin and bauxite might enhance this process further. Theory indicates that nucleation mechanisms, which form tiny submicron particles which are difficult to remove, might be inhibited by decreasing the temperature quench rate below 600 K/s. The combustor experiments were guided by selected bench scale experimental studies, which focused on the influence of substrate properties in the vaporization and condensation of volatile alkali metals, and were utilized to determine those additives subsequently tested in the combustor. For all coals considered, it was evident that some degree of enrichment of the more volatile species in the smaller particle sizes does occur. The level to which this effect was important depended on both the ash content and the rank of the coals considered. The degree to which the nucleation and condensation process could be programmed via control of temperature quench rate also varied with coal type, with the most pronounced effects being observed for the high-alkali coal. More extensive work must be done to ascertain whether the results obtained with the laboratory scale studies can be applicable to practical full scale systems. 42 refs.

39058 (DOE/PC/70779—15) Studies of metal/carbon surface chemistry: Quarterly report, March 1, 1987-May 31, 1987. Koel, B.E. (Colorado Univ., Boulder (USA). Dept. of Chemistry). 30 Jun 1987. Contract FG22-84PC70779. 6p. NTIS, PC A02/MF A01;1; GPO Dep. Order Number DE88011265/JAW.

The purpose of this research is to identify stable surface species formed from molecular adsorption and reaction on metal/carbon surfaces. This research has practical application in improving the fundamental understanding of catalytic coal gasification. Well-defined model catalysts for carbon gasification will be studied by vapor depositing alkali and transition metal atoms on carbon surfaces. Vibrational spectroscopy using HREELS and photoelectron spectroscopy of these surfaces are being used to develop an atomic-level understanding of the chemical bonding, structure, and reactivity of the metal/carbon surface and of the adsorbed molecular species.

39059 (DOE/PC/71257—T15) Novel experimental studies for coal liquefaction: Quarterly progress report, January 1, 1988-March 31, 1988. Holder, G.D.; Tierney, J.W. (Pittsburgh Univ., PA (USA). Dept. of Chemical and Petroleum Engineering). 1988. Contract FG22-84PC71257. 42p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88010828/JAW.

Research is being carried out in this project in two areas which are of interest to ongoing investigations at the Pittsburgh Energy Technology Center (PETC). They are: (1) behavior of slurry reactors used for indirect coal liquefaction, and (2) coal liquefaction under supercritical conditions. In the work with slurry reactors, the synthesis of methanol from CO and H_2 via methyl formate is being addressed. The catalyst used is copper-chromite. Thermodynamics are discussed. Supercritical fluid extraction was performed with a CO_2-naphthalene system. 49 refs., 13 figs., 4 tabs.

39060 (DOE/PC/79928—T1) Solid superacids as coal liquefaction catalysts: Quarterly report, October-December 1987. Tierney, J.W.; Wender, I. (Pittsburgh Univ., PA (USA). Dept. of Chemical and Petroleum Engineering). 1987. Contract FG22-87PC79928. 7p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE88008331/JAW.

This research will evaluate the use of solid superacids as catalysts in coal liquefaction. A literature survey was done to identify ways to synthesize solid acids such as $Fe_2O_3SO_4$/sup 2minus/. This and similar oxides can have very high acidities depending upon the method of synthesis and the anion. Preliminary experiments were carried out to synthesize an $Fe_2O_3SO_4$/sup minus2/ catalyst. The experimental procedure to measure acid strength (H/sub o/) of such solids is being developed. (10 refs., 1 fig.)

39061 (DOE/PC/80507—T10) Catalytic coal gasification: Identification of active sites: Reporting period, January 15, 1988-April 14, 1988. Falconer, J. L.; Lauderback, L. L. (Colorado Univ., Boulder (USA)). 18 Apr 1988. Contract FG22-85PC80507. 6p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE88008307/JAW.

This research uses transient isotope tracing, at steady-state reaction conditions, in combination with surface analysis techniques (secondary ion mass spectrometry (SIMS) and x-ray photoelectron spectroscopy (XPS)). Carbon dioxide gasification of carbon blacks and coal char will be used initially, since this appears to be rate-determining during steam gasification; steam gasification will be used in later experiments. In a typical isotope tracing experiment, $^{12}CO_2$ flow over a carbon-catalyst mixture will be quickly replaced by $^{13}CO_2$ at the same pressure and flow rate. The changes in the concentrations of ^{12}CO and ^{13}CO products, and in the $^{12}CO_2$ and $^{13}CO_2$ concentrations, as a function of time, will be measured with a computer-controlled mass spectrometer. The use of isotope transients allows the concentration of active catalytic sites to be measured directly at reaction conditions and it allows the rate constant to be measured. Isotope tracing will be carried out as a function of reaction temperature, catalyst loading, catalyst type and carbon conversion. Surface analysis techniques will be used to determine the active forms of the catalysts. Model studies of catalyst-carbon interactions will also be carried out with SIMS in order to determine the form of surface species. The combination of isotope tracing and surface analysis will elucidate the details of the reaction mechanism. This insight into the mechanism of coal gasification will help in improving process kinetics for gasification.

39062 (DOE/PC/90534—10) Supercritical fluid chromatography/supersonic jet spectroscopy: Progress report, March 1, 1988-May 31, 1988. Goates, S.R.; Lee, M.L. (Brigham Young Univ., Provo, UT (USA). Dept. of Chemistry). 1988. Contract FG22-86PC90534. 8p. NTIS, PC A04/MF A01;1; GPO Dep. Order Number DE88012254/JAW.

Work this past quarter has included chromatographic trials through a packed column using direct expansion supersonic jet detection with both perylene and benzo[a]pyrene as test compounds, and analysis by this method of perylene and benzo[a]pyrene in a coal tar extract. Sensitivity is limited by noise well above the dark noise level. An extensive search for the sources of this noise was conducted with only moderate success. Testing for chromatographic trials through a 50μ capillary column using the high pressure sheath flow nozzle was initiated, and work on both the direct expansion and sheath-flow pulsed nozzles was continued. The optical apparatus for the four-wave mixing experiment has been constructed. Finally, plans were drawn for an interface of the high pressure sheath-flow (back-pressure regulated) nozzle to a flame-ionization detector, but the problem of feeding in the fuel for the flame is being given further consideration before construction of the interface. 2 refs., 3 figs.

39063 (INIS-mf—11702) Prototype plant for nuclear process heat (PNP). Work on determination of plant design (HTR, HKV). Final report. Kesel, W.; Schiffgen, U.; Strauss, W. (Rheinische Braunkohlenwerke A.G., Koeln (Germany, F.R.); Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.)). Jul 1987. 87p. (In German). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88754013/JAW.

Within the scope of the project entitled 'Prototype Plant for Nuclear Process Heat', the Rheinische Braunkohlenwerke AG has developed the hydrogasification of coal (the so-called 'HKV' process). The present report describes the planning of the overall plant, which has been performed in cooperation with the other project

partners, and the planning of the hydrogasification of coal. Based on the operating results obtained in a semi-technical test plant as well as in a pilot plant and on previous project studies, process schemes were prepared for commercial lignite hydrogasification plants where the energy required for producing SNG, hydrogen and methanol is supplied by nuclear process heat from high-temperature nuclear reactors. The results have shown that in comparison with autothermal gasification processes hydrogasification using nuclear process heat opens up the possibility of saving considerable amounts of feed coal. Another advantage are the low emissions produced. Since, however, product costs are far above current market prices and exceed also those obtained with autothermal gasification processes, economic efficiency can be expected in the long run only. (orig.) With 9 tabs., 7 figs.

39064 **(LBL—24531) Fundamental studies of catalytic gasification: Quarterly report, October 1, 1987-December 31, 1987.** Heinemann, H.; Somorjai, G.A. (Lawrence Berkeley Lab., CA (USA)). Dec 1987. Contract AC03-76SF00098. 24p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88008391/JAW.

In the catalytic steam gasification of chars, North Dakota lignite char was selected for an investigation of ash component-catalyst interaction because of its high mineral content. Both nickel and potassium seem to react with minerals in the ash, greatly reducing catalytic activity of the nickel-potassium catalyst. Ash components initially catalyze gasification in the absence of an added catalyst, but this activity rapidly declines with time. When a nickel-potassium catalyst is added to the char after its gasification activity has ceased, gasification resumes with good activity and steady state gas production until almost all carbonaceous matter has been gasified. Demineralization of the char by HCl/HF treatment resulted in a char which had no catalytic activity of its own, but which was easily gasified after impregnation with Ni/K catalyst. Gasification proceeded at steady state and without the poisoning of activity observed in the presence of mineral matter. Potassium appears to interact with calcium in the ash giving an eutecticum which wets the carbon and acts as a gasification catalyst, which is superior to either potassium or calcium alone in the absence of ash. Alkali earth-alkali mixtures must therefore be investigated as potential catalysts. Nickel alone is very sensitive to the ash content of the char, apparently due to interaction between nickel and either calcium and/or sulfur. It has almost no activity for gasifying the North Dakota char in contrast to a short lived high level activity in the gasification of graphite and of low ash chars. 17 refs, 4 figs., 4 tabs.

39065 (NUSE—8501, pp 149-154) **Modification of mordenite by chemical vapour deposition of metal chloride.** Hidalgo, C.V.; Kato, Masaaki; Hattori, Tadashi; Niwa, Miki; Murakami, Yuichi. (Nagoya Univ., Faculty of Engineering, Nagoya, Japan). Feb 1985. Nagoya Univ., Research Center for Resource and Energy Conservation. Furo-cho, Chikusa-ku, Nagoya.

In FY 1982-1983 Report of Nagoya Univ., Research Center for Resource and Energy Conservation.

This paper presents a new modification method of mordenite by the chemical vapour deposition of metal chloride. The amount of deposition and the behaviours of activity of catalyst and deposition depend upon the type and treating conditions of metal chloride. Carbon tetrachloride enters the pores of zeolite at room temperature and reacts with acidic site in the passage. Although parts of germanium tetrachloride and titanium tetrachloride get into the pores of zeolite, the deposition is limited to the entrance of passage, while tin tetrachloride deposits on the outside surface of pore whether the pore is open or not. The catalytic activity of mordenite modified by the chemical vapour deposition of those compounds is different from that of parent material, mordenite, in the methanol conversion on that modified mordenite. The increase of the selectivity to C_1 to C_8 hydrocarbons and decrease of polymethylbenzene in aromatic compounds depend upon the structure of core rather than the acidity. (7 figs, 3 tabs, 12 refs)

39066 (NUSE—8501, pp 143-148) **Role of acid property of various zeolites in the methanol conversion to hydrocarbons.** Ito, Hirofumi; Hidalgo, C.V.; Hattori, Tadashi; Niwa, Miki; Murakami, Yuichi. (Nagoya Univ., Faculty of Engineering, Nagoya, Japan). Feb 1985. Nagoya Univ., Research Center for Resource and Energy Conservation. Furo-cho, Chikusa-ku, Nagoya.

In FY 1982-1983 Report of Nagoya Univ., Research Center for Resource and Energy Conservation.

Catalytic performance of various zeolite in the methanol conversion process was investigated from the acidity measured by the temperature-programmed desorption of ammonia. It was found that the catalytic activity is proportioned to the amount of strong-acidic site defined as the amount of ammonia desorbed at a temperature of 573K or more. The distribution of products is closely correlated with the amount of strong-acidic site. C_4^- paraffinic compounds, ethylene and aromatic compounds increase and C_8(female) aliphatic compounds, propylene and butene decrease, as the strong-acidic site decreases. The alkaline ion-exchange increases C_8(female) aliphatic and aromatic compounds. ZSM-5 is characterized by the low selectivity to polyalkylbenzene due to the selectivity to the configuration. (6 figs, 1 tab, 20 refs)

39067 (NUSE—8501, pp 135-142) **Measurement of the acidity of various zeolites by temperature-programmed desorption of ammonia.** Hidalgo, C.V.; Ito, Hirofumi; Hattori, Tadashi; Niwa, Miki; Murakami, Yuichi. (Nagoya Univ., Faculty of Engineering, Nagoya, Japan). Feb 1985. Nagoya Univ., Research Center for Resource and Energy Conservation. Furo-cho, Chikusa-ku, Nagoya.

In FY 1982-1983 Report of Nagoya Univ., Research Center for Resource and Energy Conservation.

Acidity of H-type zeolites including mordenite, ZSM-5, Y-faujasite and their modifications by cation exchange or dealumination was measured by the temperature-programmed desorption (TPD) of ammonia. Ammonia is desorbed at 373K and the spectral resolution is improved except the participation of the extreme weak-acidic site. The TPD spectra of mordenite and ZSM-5 zeolites show the maximum peaks of desorption at 420 and 680K, respectively. The order of acid strength of these zeolites was found from the spectra of desorption temperature. The amount of acid can be determined from the desorbed amount of ammonia, relating to the infrared spectral band intensity at 3600 cm^{-1} of OH and 1440 cm^{-1} of ammonium. (9 figs, 1 tab, 23 refs)

39068 (NUSE—8601, pp 112-122) **Fine control of the pore-opening size of the zeolite mordenite by chemical vapor deposition of silicon alkoxide.** Niwa, Miki; Kato, Satoshi; Hattori, Tadashi; Murakami, Yuichi. (Nagoya Univ., Faculty of Engineering, Nagoya, Japan). Feb 1986. (In Japanese). Nagoya Univ. Nagoya, Japan.

In FY 1984 Report of Nagoya Univ., Research Center for Resource and Energy Conservation.

CVD of $Si(OCH_3)_4$ on the H form of mordenite is carried out to control the pore-opening size without affecting its acidic properties. $Si(OCH_3)_4$ is deposited irreversibly on the zeolite. Because the molecular size of the alkoxide is larger than the pore size, the alkoxide does not enter the pore and the silicon compound is deposited on the external surface. The alkoxide may be deposited by reaction with hydroxide, thus covering the external surface of zeolite crystal after subsequent reactions. Calcination with oxygen removes the hydrocarbon residue and produces silica-coated H-mordenite (SiHM). The SiHM thus obtained has been characterized by temperature-programed desorption of MH_3, adsorption experiments and X-ray photoelectron spectroscopy. (6 figs, 2 tabs, 23 refs)

39069 (NUSE—8601, pp 101-111) **Fine control of pore size of H-mordenite by vapor-phase deposition of $Si(OCH_3)_4$.** Niwa, Miki; Morimoto, Shoji; Kato, Masaaki; Hattori, Tadashi; Murakami, Yuichi. (Nagoya Univ., Faculty of Engineering, Nagoya, Japan). Feb 1986. (In Japanese). NTIS (US Sales Only), PC A06/MF A01.

In FY 1984 Nagoya Univ., Research Center for Resource and Energy Conservation.

A new method of fine control of the zeolite pore size is proposed and exemplified by the excellent high shape-selective cracking of paraffins. C_6 paraffins mixture of octane, 3-methylheptane and 2,2,4-trimethylpentane are sieved on the SiO_2- deposited H-modernite, and smaller molecules only are converted into lower hydrocarbons. Products on the modified mordenite included linear paraffins more than that expected from the thermodynamics equilibrium, thus indicating the product shapes-selectivity. Furthermore, sorption studies of C_6 paraffins indicated the enhancement of selective sorption of linear paraffin, which was caused by the gradual suppression of sorption rate due to the pore opening control. (7 figs, 1 tab, 10 refs)

39070 **(PB—88-186804/XAB) Dynamic modeling of a pilot-scale fluidized-bed coal-gasification reactor.** Rhinehart, R.R.; Felder, R.M.; Ferrell, J.K. (Environmental Protection Agency, Research Triangle Park, NC (USA). Air and Energy Engineering Research Lab.). 1987. 10p. (EPA—600/J-87/306). NTIS, PC A02/MF A01.

Pub. in Industrial Chemistry Engineering Research 26, 738-745(1987).

This paper describes a dynamic mathematical model of a pressurized fluidized-bed coal-gasification reactor, developed and used to correlate data from a pilot-scale reactor. The model accounts for pyrolysis, oxidation, char gasification, and subsequent gas-phase reactions, fines elutriation, and heat losses from the reactor, and simulates both transient and steady-state operation. If the values of three model parameters are adjusted to fit data obtained during steady-state operation, the model yields good predictions of 11 reactor state variables and dynamic response to an upset in operating conditions, and so provides an excellent basis for adaptive supervisory control of the reactor.

39071 **(PB—88-202643/XAB) Mechanical properties of materials in coal-gasification environments. Final report, April 1980-December 1983.** Brown, R.D.; Lyle, F.F.; Page, R.A.; Wei, W. (Materials Properties Council, Inc., New York (USA)). Aug 1987. 83p. (REPT—06-6076). NTIS, PC A05/MF A01.

Stress-rupture tests were conducted in a flowing CGA environment on specimens of Incoloy 800H, Type 310 stainless steel, and RA 333. Detailed metallographic analyses were conducted on selected specimens. Stress-rupture lifetimes were inversely related to the degree of corrosion experienced by test specimens. Specimens displaying short lifetimes and early onset of tertiary creep experienced the most-severe corrosion attack. Conversely, specimens displaying longer lifetimes and appreciable secondary creep before initiation of secondary creep experienced less corrosive attack. However, lifetimes under nominally equivalent conditions varied widely. Corrosion damage initially occurred as internal corrosion below the protective oxide surface films formed on alloys. Internal sulfidation, oxidation, and carburization occurred in three alloys. Increased corrosion damage is a localized phenomenon related to transport of sufficient sulfur through protective oxide films to form internal sulfides. The results of metallographic evaluation of selected specimens suggest that increased creep rates accelerate sulfur penetration and subsequent internal and external corrosion, since the most severe corrosion damage occurred in highly stressed regions where creep rates were greatest.

39072 **(PB—88-205802/XAB) Development of thermophysical-property data for fossil-fuel gasification processes. Final report. January 1983-November 1984.** Anderson, G.L.; Hill, A.H. (Institute of Gas Technology, Chicago, IL (USA)). Jan 1987. 207p. NTIS, PC A10/MF A01.

The report presents the results of a program planning effort conducted for Gas Research Institute (GRI). The objective was to prepare a 5-year program plan for GRI for the acquisition of thermophysical property data that are considered important for improving the design and decreasing the cost of future coal-gasification plants. Based on a literature review and input from engineers and scientists actively engaged in either coal-gasification or thermophysical properties work, a 5-year program was formulated. The program consists of simple and complex phase-equilibrium studies on raw-fuel-gas quench systems, similar studies on sour-water strippers, and the development of a three-phase, multicomponent vapor-liquid-liquid equilibrium program to be used for quench-system design and other purposes.

39073 **(PB—88-205810/XAB) High-temperature corrosion in coal-gasification systems. Final report. (October 1972-December 1985).** Howes, M.A.H. (Materials Properties Council, Inc., New York (USA)). Aug 1987. 127p. NTIS, PC A07/MF A01.

See also DE—84-005412.

A comprehensive study of high-temperature, high-pressure corrosion has been carried out to simulate the effects of various synthetic coal gases as materials of construction, including welds. In the last years of the study, some interpretive work was conducted, particularly into the phenomenon of a suddenly increasing corrosion rate after a long period of relatively stable behavior which has been termed break-away corrosion. This was of particular interest since it prevents the extrapolation of data unless the onset of breakaway corrosion could be predicted. Time to onset of breakaway corrosion seems to be affected by alloy composition (particularly chromium content), temperature, pressure, and atmosphere (particularly the sulfur potential). The data are now available in the form of a computerized data base, which can be searched readily to find the material most suited for particular combinations of exposure conditions.

39074 **(PB—88-205885/XAB) Chemisorption, reaction, and desorption studies of coal chars in steam, oxygen, and carbon dioxide. Annual report, January-December 1987.** Radovic, L.R.; Lizzio, A.A. (Pennsylvania State Univ., University Park (USA). Davey Lab.). Apr 1988. 84p. NTIS, PC A05/MF A01.

See also report dated Jan 87, PB—87-207403.

An in-depth evaluation of selected theoretical models of char gasification kinetics was performed. These models, which predict char reactivity based on the evolution of total surface area with conversion, were tested using the gasification data generated in the study. A reinterpretation of the models showed that they also implicitly predict the variation of active surface area with conversion. Their predictions were compared to experimentally observed variations of ASA with conversion for a wide range of carbon materials. The effect of stable carbon-oxygen complex formation on reactivity profiles obtained by thermogravimetric analysis was investigated. This phenomenon is responsible for the observed differences in the reactivity profiles of a bituminous coal char in oxygen and carbon dioxide.

39075 **(PB—88-211966/XAB) Design and economics of a plant to convert western subbituminous coal to SNG (substitute natural gas) using KRW (KRW Energy Systems Inc.) gasifiers. Topical report (Final) May 1985-January 1986.** Smith, J.T.; Hanny, D.J.; Smelser, S.C. (Fluor Technology, Inc., Irvine, CA (USA)). Jan 1986. 116p. NTIS, PC A06/MF A01.

A first-pass design and cost estimate indicates that the levelized constant-dollar cost of gas for a 125 billion Btu/day plant to convert western subbituminous coal to substitute natural gas (SNG) using KRW gasifiers is $4.70/MMBtu. Process development allowances (PDA) increase the gas cost to $5.09/MMBtu. The levelized constant-dollar gas cost for a scaled-up 250 billion Btu/day plant is estimated at $4.17/MMBtu, indicating that smaller plants can be constructed with less capital risk while producing methane at only slightly higher costs.

39076 **(PB—88-211974/XAB) Single-train demonstration plant to convert eastern bituminous coal to methane or electricity using ash-agglomerating, fluidized-bed gasification. Final topical report, June 1986-October 1986.** Smelser, S.C. (Fluor Technology, Inc., Irvine, CA (USA)). Oct 1986. 85p. NTIS, PC A05/MF A01.

A first-pass screening design and rough-order-of-magnitude (ROM) cost estimate was prepared for a single-train demonstration plant to convert bituminous coal to methane and electricity using an ash-agglomerating, fluidized bed process. The total plant investment, with contingency and process development allowances, is estimated at $188 million (1986 dollars). If built separately, the meth-

ane plant is estimated to cost $136 million, and the integrated coal gasification combined-cycle (IGCC) plant is estimated to cost $143 million. Operating costs for the five-year demonstration period are estimated at about $33 million/year.

39077 **(PB—88-211982/XAB) Design and economics of a lignite-to-SNG (substitute natural gas) facility using Lurgi gasifiers with in-line conversion of by-product liquids to methane. Topical report (Final), December 1985-November 1986.** Smelser, S.C. (Fluor Technology, Inc., Irvine, CA (USA)). Nov 1986. 103p. NTIS, PC A06/MF A01.

A first-pass conceptual design and screening cost estimate was prepared for a hypothetical plant to convert lignite to methane using Lurgi dry-bottom gasifiers and employing a black box reactor to convert by-product liquids in the gas phase to methane. Results were compared to those from conventional and modified Lurgi-plant designs. The in-line conversion plant can potentially reduce the cost of gas from a Lurgi plant by about 20%. Due to reduced capital investment, over $200 million could be invested in the reactor before the cost of gas from the in-line conversion plant is as high as that of a Lurgi plant.

39078 **(PB—88-211990/XAB) Design and economics of plants to convert eastern bituminous coal to methane using KRW gasifiers with and without in-bed desulfurization. Topical report, March 1986-January 1987.** Smith, J.T.; Smelser, S.C. (Fluor Technology, Inc., Irvine, CA (USA)). Jan 1987. 156p. NTIS, PC A08/MF A01.

First-pass designs and cost estimates indicate that an eastern bituminous coal-to-methane plant utilizing in-bed desulfurization with KRW gasification provides an economic advantage of $0.39/MMBtu over KRW gasification without in-bed desulfurization. The economic benefits depend directly on the value of export power. When the zinc ferrite desulfurization unit is not used in conjunction with in-bed desulfurization ($5.85/MMBtu), half of the benefits of in-bed desulfurization ($5.63/MMBtu) over the conventional KRW plant ($6.02/MMBtu) is lost. Use of combined shift/methanation ($5.09/MMBtu) or direct methanation ($5.30/MMBtu) in conjunction with in-bed desulfurization further reduces the cost of gas.

39079 **(PB—88-212006/XAB) Design and economics of a plant to convert western subbituminous coal to pipeline gas using dry-feed, entrained flow gasifiers. Topical report, January 1987-May 1987.** Sandler, H.S.; Smelser, S.C. (Fluor Technology, Inc., Irvine, CA (USA)). May 1987. 93p. NTIS, PC A05/MF A01.

A first-pass design and cost estimate was prepared for a plant to convert western subbituminous coal to pipeline gas using dry-feed, entrained-flow (Shell-type) gasifiers with GRI's fixed-bed direct-methanation process. Results indicate that this plant could produce pipeline gas at a cost competitive with the Lurgi process using lignite coal, and slightly more expensive than gas produced from the KRW process. The plant design's overall thermal efficiency is lower than that of the KRW Wyodak or the Lurgi Lignite designs. The levelized constant-dollar cost of gas for the 125 billion Btu/day dry-feed, entrained-flow plant is estimated at $5.17/MMBtu.

39080 **Lanthana-promoted Rh/SiO_2. II. Studies of CO hydrogenation.** Underwood, R.P.; Bell, A.T. (Lawrence Berkeley Lab., CA (USA)). *Journal of Catalysis;* 111: No. 2, 325-335(Jun 1988). Contract AC03-76SF00098.

A study of the influence of lanthana promotion on the hydrogenation of CO over Rh/SiO_2 has been conducted. Lanthana-promoted Rh/SiO_2 exhibits higher turnover frequencies for the synthesis of CH_4, C_2-C_4 hydrocarbons, CH_3OH, and C_2 oxygenates than unpromoted Rh/SiO_2. The turnover frequency for each product goes through a maximum with increasing lanthana addition. Lanthana promotion is also found to increase the selectivity for the formation of CH_3OH, C_2 oxygenates, and C_2-C_4 hydrocarbons and to decrease the selectivity for CH_4. The selectivity for C_2 oxygenates is optimized at low levels of lanthana addition. In situ infrared observations show that lanthana promotion blocks the chemisorption of CO onto surface Rh sites. Of particular interest is the observation of a band at 1725 cm^{-1}. This feature is assigned to CO adsorbed on a Rh site immediately adjacent to an LaO/sub x/ island. The low frequency of this vibration is attributed to a weakening of the C-O bond caused by the interaction of lanthana cations with the oxygen end of the adsorbed CO. It is postulated that the interaction of the lanthana with the CO is responsible for the enhanced rates of CO dissociation and the formation CH_4 and C/sub 2+/ products. Infrared spectroscopy also provides evidence for acyl, formate, and acetate groups on the surface of lanthana-promoted Rh/SiO_2. The possible role of these species in the synthesis of products is discussed. 26 references.

0105 By-products

REFER ALSO TO CITATION(S) 39074, 41242

39081 **(PB—88-864483/XAB) Coal Tar Technology. January 1970-May 1988 (Citations from the NTIS data base). Report for January 1970-May 1988.** (National Technical Information Service, Springfield, VA (USA)). May 1988. 159p. NTIS PC N01/MF N01.

Supersedes PB—87-860342.

This bibliography contains citations concerning various aspects of coal tar. Topics include production from coal gasification, synthesis of chemicals from coal tar, and chemical analyses of coal-tar products. Toxicology, pollution studies, and commercial uses of the product are also discussed. (This updated bibliography contains 269 citations, 22 of which are new entries to the previous edition.)

0106 Properties

REFER ALSO TO CITATION(S) 39050, 39058, 39059, 39081, 39092, 39101, 39123

39082 **(DOE/PC/60037—T8) Reports of investigations on: Derivation of an infinite-dilution activity coefficient model and application to two-component vapor/liquid equilibria data: Final report.** Roper, V.P.; Kobayashi, R. (Rice Univ., Houston, TX (USA). Dept. of Chemical Engineering). Feb 1988. Contract FG22-83PC60037. 325p. NTIS, PC A14/MF A01; GPO Dep. Order Number DE88007517/JAW.

Infinite-dilution fugacity coefficients were obtained for the system fluorene/phenanthrene at thirteen temperatures by fitting total pressure across the entire mole fraction range by a computer routine. A thermodynamically consistent routine, that allowed for both positive and negative pressure deviations from the ideal values, was used to correlate data over the full mole fraction range from 0 to 1. The four-suffix Margules activity coefficient model without modification essentially served this purpose since total pressures and total pressure derivatives with respect to mole fraction were negligible compared to pressure measurement precision. The water/ethanol system and binary systems comprised of aniline, chlorobenzene, acetonitrile and other polar compounds were fit for total pressure across the entire mole fraction range for binary Vapor-Liquid-Equilbria (VLE) using the rigorous, thermodynamically consistent Gibbs-Duhem Relation derived by Ibl and Dodge. Data correlation was performed using a computer least squares procedure. Infinite-dilution fugacity coefficients were obtained using a modified Margules activity coefficient model.

39083 **(DOE/PC/79903—T1) Optical properties of fly ash: Quarterly report for period 15 September-31 December 1987.** Self, S.A. (Stanford Univ., CA (USA). High Temperature Gasdynamics Lab.). Jan 1988. Contract AC22-87PC79903. 44p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88011025/JAW.

The general aims of this research are to provide a fundamental scientific basis for the physical understanding and reliable calculation of radiative heat transfer in coal combustion systems, particularly as it is influenced by the presence of inorganic constituents deriving from the mineral matter in coal. This work is funded under two tasks: The chemical composition and size distribution of representative flyashes will be measured by appropriate microanalytical techniques; and, measurements of the infrared optical constants of synthetic slags will be made as a function of wavelength and tem-

perature for controlled compositions. Particular attention will be given to the contribution of the Fe_2O_3 content and its valence state. Progress has been made in both these areas, as reported in the Quarterly Report, and summarized below. 11 refs., 9 figs., 2 tabs.

39084 **(DOE/PC/90519—T6) Electrochemical characterization and derivation of coal: Technical progress report, March 15, 1988-June 15, 1988.** Park, S.M. (USDOE, Washington, DC; New Mexico Univ., Albuquerque (USA). Dept. of Chemistry). 1988. Contract FG22-86PC90519. 11p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88011901/JAW.

We have been working on two subprojects: oxidation of humic acids in acidic media and theoretical treatment of electrochemical processes occurring during the oxidation/reduction of coal/humic acids in the presence of solution catalysts. The oxidation of humic acids was studied for two purposes: 1) as a preliminary study for coal/humic acids derivatization, and 2) as a model for understanding the oxidation of coal. Results indicate that a large fraction of hydroxide groups on humic acids is oxidized to produce hydrocarbons as a product. 5 refs., 5 figs.

39085 **(DOE/PC/90521—T6) Role of porosity in supercritical fluid extraction of coal: Technical progress report.** Bale, H.D. (North Dakota Univ., Grand Forks (USA). Dept. of Physics). 15 Jun 1988. Contract FG22-86PC90521. 9p. NTIS, PC A02/MF A01;1; GPO Dep. Order Number DE88011661/JAW.

Primary effort has focused on our scattering studies of Wyodak subbituminous coal. By repetition and by varying the extraction conditions we have been able to interpret the scattering results with more confidence and hence gain a clearer picture of the role of porosity in supercritical fluid extraction. We discuss qualitatively, four modifications in the pore structure that occur as a result of temperature and pressure conditions during extraction. 2 figs.

39086 **(DOE/PC/90528—T1) Thermodynamics of coal liquid/solid systems: Quarterly progress report for the period October 16, 1987 to December 15, 1987.** Holder, G.D. (Pittsburgh Univ., PA (USA). Dept. of Chemical and Petroleum Engineering). May 1988. Contract FG22-86PC90528. 5p. NTIS, PC A02/MF A01;1; GPO Dep. Order Number DE88011189/JAW.

The effluent streams of coal liquefaction processes often contain both liquids and solids (THF or pyridine insolubles). The solids appear to affect the physical properties of these liquids due to the adsorption of the heavy liquid components on the coal surface. The design of liquefaction reactors and separation units is dependent to a great extent on the thermodynamics of these multicomponent, multiphase mixtures. We are currently investigating the effect of coal solids on the vapor pressure of multicomponent systems containing coal solids. The results obtained thus far indicate a dramatic effect of the coal solids on vapor pressure of coal liquids. A 50 percent increase in the vapor pressure of a liquid from the Wilsonville pilot plant was observed when coal solids were added. This effect is attributed to the adsorption of heavier liquid components on the coal surface, as these heavies are preferentially absorbed, leaving a lighter liquid solution with a higher vapor pressure. The adsorption of heavy components results in sharper and easier separation of the lighter unadsorbed liquid. Chemical reactions are also affected by the adsorption of the heavier components as they become unavoidable for conversion to lighter compounds. This work aims to quantify the effect of this adsorption through a methodical study of the properties of both heavy liquid model compounds and actual coal liquids with and without coal solids. 21 refs.

39087 **(DOE/PC/90913—T6) Biochemical bond breaking in coal: Literature review.** Wyza, R.E.; Doyle, R.C.; Isbister, J.D. (Atlantic Research Corp., Alexandria, VA (USA)). 24 Apr 1987. Contract FG22-86PC90913. 40p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88008820/JAW.

Coal structure, biodegradation, and solubility are discussed for lignites, bituminous and subbituminous coals. 39 refs., 1 fig., 2 tabs.

39088 **(DOE/PC/90961—T7) Laser velocimeter measurements of solids in multiphase flow: Technical progress report for the period March 1, 1988-May 31, 1988.** Kadambi, J.R. (Case Western Reserve Univ., Cleveland, OH (USA). Dept. of Mechanical and Aerospace Engineering). 1988. Contract FG22-86PC90961. 8p. NTIS, PC A02/MF A01;1; GPO Dep. Order Number DE88011611/JAW.

Preliminary tests were conducted using water as the fluid in the refractive index matched multiphase flow loop. Laser Doppler Velocimeter was used for measuring the fluid velocity along a horizontal diameter located 17 feet downstream of the pump. The tests were conducted in the Reynolds number range of 1000 to 3000. In addition to LDV velocity measurements, pressure drops as well as flow rates were also measured. Representative velocity profiles and pressure drop data are presented. The test loop was then filled with the refractive index matched fluid, 55% (by weight) sodium iodide solution in water. The velocity profile for a representative data point and pressure drop data is shown. 5 figs.

39089 **(PB—88-194717/XAB) Bulletin of the National Research Institute for Pollution and Resources, Vol. 17, No. 1, August 1987.** (National Research Inst. for Pollution and Resources, Yatabe, Ibaraki (Japan)). 1987. 58p. NTIS, PC E04/MF A01.

Text in Japanese with English abstracts. See also PB—88-130927; Portions of this document are not fully legible.

Contents included: Measurement on the dielectric voltage of the coals; Characterization of highly concentrated coal water mixture (CWM); Kinetic study on the hydrodemetallation of residual oil; Studies on accumulation of sugar in activated sludge; 2. and effect of pH on sugar accumulation under the condition of nitrogen deficiency (in English).

39090 **(PB—88-205083/XAB) Nucleation properties of respirable coal dust. Terminal progress report.** Schowengerdt, F.D.; Brown, J.T. (Colorado School of Mines, Golden (USA). Dept. of Physics). 1978. 78p. NTIS, PC A05/MF A01.

Studies on the interaction of respirable coal dust with water vapor was conducted. A continuous-flow thermal-diffusion cloud chamber (spectrometer) was used to observe nucleation and growth of water droplets in the presence of coal dust, and measurements were taken of growth of water droplets on particulates in real time and as a function of supersaturation and residence time, and of the nucleation efficiencies for water vapor on coal dust. It was found that nucleation and growth of water droplets to sizes of several microns on coal dust in the respirable size range occurred under conditions of moderate supersaturation in times of less than 3 seconds. It is suggested that droplet growth measurements would be useful in any problem involving interactions between particulates and water vapor, such as dust elimination, pollutant washout in precipitation, and inhalation toxicology.

39091 **The why and how of coal-quality research in the U.S. Dept. of Energy.** Harrington, R.E. (U.S. Dept. of Energy (US)). pp 95-102 of Symposium proceedings: A national agenda for coal quality research. Garbini, S.; Schweinfurth, S.P. Alexandria, VA; U.S. Geological Survey (1986). (CONF-8504287—).

From Symposium on a national agenda for coal quality research; Reston, VA, USA (9 Apr 1985).

This article explains why and how the Department of Energy (DOE) is pursuing research relating to coal quality. The DOE would like coal to get back into areas dominated by gas and oil to improve our national security and fuel-wise balance. Progress is being made in developing coal-derived fuels and machines. The current research is looking at how to adapt and optimize energy-conversion machines to use coal-derived fuel forms.

0108 Waste Management

REFER ALSO TO CITATION(S) 39054, 40429, 40757, 41309, 41331, 41332

39092 **(CRANZ-TP—29) Calculation of flue-gas losses 1986.** (Coal Research Association of New Zealand, Wellington). May 1986. 11p. Coal Research Association of New Zealand, Wellington.

An accurate method for the calculation of flue gas losses from a combustion process is described, covering the wide range of coal rank encountered with New Zealand industrial coal. The information required for the calculation is - flue gas analysis; flue gas temperature; coal analysis (as fired) - moisture, ash, calorific value. The accuracy of the calculations depends on allow-sulphur content in the coal and negligible incombustibles in the ash and in the flue gas. A computer program (in Fortran F77) is available which incorporates this theoretical treatment. Revised constants are calculated for use in a more convenient, but less accurate, Siegert-type formula, for the three categories of New Zealand coal. The limited accuracy of the Siegert-type formula is illustrated. 4 tabs.

39093 **(DOE/MC/22087—2543) Laboratory evaluation of high-temperature sulfur removal sorbents for direct coal-fired turbines: Final report.** Newby, R.A.; DeZubay, E.A.; Chamberlin, R.M. (Westinghouse Electric Corp., Pittsburgh, PA (USA). Research and Development Center). Jun 1987. Contract AC21-85MC22087. 453p. NTIS, PC A20/MF A01;1; GPO Dep. Order Number DE88001041/JAW.

Direct coal-fired turbine concepts currently being developed require substantial levels of sulfur removal from high-temperature gas streams. Calcium-based sorbents, limestones, dolomites, limes and lime hydrates, are capable of sulfur removal in direct coal-fired turbine combustor environments at temperature up to 1200{degree}C. Two types of desulfurizer processes are considered in this report using calcium- based sorbents: fluidized bed desulfurizer using coarse sorbent particles (300-1000 μm), and entrained desulfurizer using fine sorbent particles (1-40 μm). Small-scale laboratory tests were performed on a variety of calcium-based sorbents to determine the kinetics of sulfation and sulfidation over ranges of conditions applicable to both types of desulfurizer processes. Correlations are developed in the report for the effect of pressure; temperature, and particle size. Engineering models are also developed for both desulfurizer types that incorporate the laboratory reaction kinetics and predict potential commercial performance and performance trends. It is concluded that both desulfurizer concepts can be effective in direct coal-fired turbines, with calcium-to-sulfur molar feed ratios ranging from 1.5 to 3.0, if the correct calcium-based sorbent is selected, and if applicable design and operating conditions are identified. Both desulfurizer concepts have limitations and key development requirements, and site and fuel specific engineering assessment is required to select the best concept for a given combustor system. The influence of the desulfurizer concepts on turbine protection, through their influence on particle loading and alkali release must also be assessed. 51 refs., 73 figs., 9 tabs.

39094 **(DOE/PC/79798—T3) LIMB Demonstration Project Extension: Quarterly report No. 2 for the period August, September, October 1987.** (Babcock and Wilcox Co., Barberton, OH (USA). Contract Research Div.). 15 Jan 1988. Contract FC22-87PC79798. 41p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88008332/JAW.

Phase 1 activities emphasized Coolside sorbent evaluation, detailed engineering of the flue gas humidification chamber and bypass flues, and Coolside waste characterization. Consol completed evaluation of twelve different commercially available sorbents through a chemical and physical characterization effort and a pilot process testing effort. The Coolside demonstration sorbent will be chosen from the superior desulfurization performers based on quoted delivery prices. For Phase IIA---Site Preparation and Long-Lead Time Item Procurement, asbestos removal and demolition of the retired precipitator is complete. Under Phase IIB---Coolside and LIMB Construction, Start-Up and Shakedown, the Edgewater extended maintenance outage began on September 26, 1987. It will continue until mid-January 1988. (PSB)

39095 **(EPRI-CS—5801) Interaction between coal combustion by-products and natural liners: Final report.** Peterson, S.R.; Criscenti, L.J.; Dodson, M. (Electric Power Research Inst., Palo Alto, CA (USA); Battelle Pacific Northwest Lab., Richland, WA (USA)). Jun 1988. Contract AC06-76RL01830. 178p. NTIS, PC A09/MF A01 - Research Reports Center, Box 50490, Palo Alto, CA 94303;1; GPO Dep. Order Number DE88011776/JAW.

The hydrological and chemical changes that occur when coal combustion by-product wastes or waste leachates contact natural soil liners were investigated. Soil column experiments were conducted to study the changes in linear permeability and contaminant mobility that occur when these wastes contact coil. Eight experiments involving four different coal combustion by-product wastes (two fly ash leachates, boiler cleaning waste and water treatment system brine and two distinct soils were conducted. A geochemical computer code, MINTEQ, was used as a tool to determine the chemical processes that occurred during the soil column experiments. MINTEQ was used to perform ion speciation/solubility calculations on the leachates and to perform mass transfer calculations to test the conceptual models developed to describe the interactions between the influent waste solution and the soils. Liner failure, defined as an increase in permeability, did not occur during the 6-month time frame of these experiments; the permeabilities of the soils remained constant or decreased with time. The results indicate that the physical and chemical changes that occurred to the liners through reaction with the waste solutions were not detrimental to liner stability. It appears that the life expectancy of the soils liners is not compromised by the wastes they contain. Ion speciation/solubility calculations indicated that Fe, Al, and Si concentrations had plausible solubility controls in all eight soil columns. 43 figs., 13 tabs.

39096 **(EPRI-CS—5855) Furance sorbent injection for SO_2 reduction in cyclone-equipped boilers: Final report.** Maringo, G.J.; Hatfield, P.E.; Farzan, H.; Rodgers, L.W. (Electric Power Research Inst., Palo Alto, CA (USA); Babcock and Wilcox Co., Barberton, OH (USA)). Jun 1988. 182p. Unlimited audience, publicly available. Research Reports Center, Box 50490, Palo Alto, CA 94303;1. Order Number TI88012515/JAW.

During 1985 and 1986, the Electric Power Research Institute (EPRI), Baltimore Gas and Electric (BG and E), Atlantic Electric, and Babcock and Wilcox (B and W) cofunded a program to evaluate the potential of dry sorbent injection technology for reducing sulfur emissions from cyclone-equipped boilers. Although numerous sorbent injection investigations applying the technology to pulverized-coal-fired systems have been reported, those results cannot be translated directly to cyclone-equipped units primarily because cyclone boilers have shorter gas residence times in the sulfation window. Other differences that could affect sulfur capture by in-furnace injection of dry sorbents are the combustion gas flow patterns and the relatively low fly ash levels. Therefore, a pilot-scale project was conducted at B and W's Alliance Research Center (ARC) to address these variations and assess the applicability of this technology specifically for cyclone-equipped units. The principal objective of this test program was to determine whether furnace sorbent injection could reduce sulfur emissions in cyclone units by nominally 50% at a calcium-to-sulfur (Ca/S) molar ratio of less than/equal to 2:1 and to assess the associated boiler operability concerns. Presuming success, the project also sought to establish a sufficient data base to provide confidence to proceed with a full-scale cyclone demonstration of the technology. 29 refs., 71 figs., 19 tabs.

39097 **(L—20031981) Report on atmospheric fluid bed combustor burning washery rejects.** Prather, B.W. (Luscar Ltd., Edmonton, Alberta (Canada)). Mar 1981. vp. (CE—01349). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

Millions of tons of coal rejects are produced each year in Canadian coal washery operations. These reject materials have fairly high heating values. Yet they are discarded, often at further expense to collect and transport them to disposal sites, due to lack

of facilities that will burn these rejects and recover the energy efficiently. Clean coal or other expensive fuels have to be utilized to meet the high energy demands of the washery operations. If the coal rejects could be burned at the washery site, practically all washery energy requirements can be met and the material to be disposed of can be reduced to a sterile ash which is easier to handle and may have possible useful applications. A project was undertaken to investigate the recovery of energy in coal washery rejects using an Atmospheric Fluidized Bed Combustor (AFBC). Objective of the project was to develop a conceptual design for an AFBS system, to utilize a portion of these rejects and generate heat to supply the existing thermal coal dryer and meet plant heating load. With background information and the first hand observations of the washery operations, analytical tests were proposed and conducted, and a pilot plant test program was laid out to complete design data. Process calculations were carried out and equipment design and selection followed. A capital cost estimate of the equipment was done to complete the project. Includes 4 folded plans. 2 figs., 17 tabs.

39098 **(PB—88-184874/XAB) Flue-gas desulfurization inspection and performance evaluation. Manual.** (PEI Associates, Inc., Cincinnati, OH (USA)). Oct 1985. 315p. NTIS, PC A14/MF A01.

The intent of this manual is to provide inspectors from Federal and state environmental agencies with information regarding the problems that plague lime/limestone slurry flue-gas desulfurization (FGD) systems that will aid them in their inspections and performance evaluations of these systems with respect to compliance with the emission standards that have evolved since the passage of the 1970 Clean Air Act. A unique feature of the manual is its structure as a tool, or working document, which will accompany the inspector on each plant inspection. Thus, the document is presented in user friendly fashion and tailored to provide practical information for its intended use--to assist in the systematic inspection of an FGD system to determine present and future compliance status. The approach entails the use of nomographs, checklists, matrices, simplified diagrams, cross-referencing, and indexing of textual information, and the presentation of important guidelines and recommendations in a readily discernible fashion.

39099 **(PB—88-200746/XAB) Sulfur capture during fluidized-bed combustion of coal. External mass-transfer phenomena and the fluid-dynamical behavior of large particles. Doctoral thesis.** Noordergraaf, I.W. (Technische Hogeschool Delft (Netherlands)). 1985. 201p. (In Dutch). NTIS, PC E08/MF A01.

Fluidized-bed combustion (FBC) is an attractive technique for the production of useful energy from polluting and/or low-value fuels because it allows for in-situ sulfur capture by addition of sorbent materials to the bed. The purpose of this thesis is to obtain a basic understanding of those processes that determine the sulfur capture, as an essential step forward from empirical correlations and large computer models based on uncertain assumptions. Many experiments were carried out to study the fluid-dynamic properties of mixtures of large particles (Ch.V to VII). Data on particle mixing and segregation in fluidized beds of various sizes both at ambient and at FBC temperature (850°C) were collected. The results are used to support the assumptions for the fluidized-bed models that appear in the thesis.

39100 **(PB—88-202049/XAB) Nitric oxide destruction in the fuel-bed burning regime of spreader stokers.** Starley, G.P.; Brodbeck, D.R.; Pershing, D.W.; Martin, C.B. (Environmental Protection Agency, Research Triangle Park, NC (USA). Air and Energy Engineering Research Lab.). 1987. 6p. (EPA—600/J-87/344). NTIS, PC A02/MF A01.

Pub. in Ind. Eng. Chem. Res. Vol. 26, No. 4(1987).

This article gives results of an experimental study of nitric oxide (NO) destruction in the fuel bed of a coal-fired spreader stoker. NO was injected into the coal bed and freeboard flame zone under varying local stoichiometries to determine the fate of NO in the primary combustion zone. In general, a high capacity for NO reduction was observed, with bed-phase reduction contributing most significantly to the overall mechanism. Fractional survival of injected NO, as well as fuel nitrogen conversion to exhaust NO, decreased with decreasing bed-region stoichiometry. Staged firing also decreased NO survival by increasing residence time in the fuel-rich primary combustion zone. The modest nitrogen oxides (NOx) reductions achievable with Flue Gas Recirculation (FGR), a practical NOx control technique, are due in part to the more than 50% destruction of NO in the recycled flue gases.

39101 **(PB—88-206131/XAB) Reactivity of coal and the prevention of spontaneous heating in coal stockpiles and discard dumps in South Africa, incorporating report Nos. 8404, 8507, and 8509.** Coetzee, S.D. (National Inst. for Coal Research, Pretoria (South Africa)). 1986. 112p. (COAL—8615). NTIS, PC E07/MF E07.

See also PB—88-102843; North American Continent sales only.

Coalification is a process in which molecular order is being derived from disorder. Quantum-mechanical energy levels are initiated that increase in energy with rise in overburden pressure, but on erosion or removal of pressure the surplus energy is spent spontaneously. The formation of coal is reviewed, bearing in mind quantum-mechanical reactions in macromolecules as well as the configuration of the system (coal molecule) which is capable of existing in a stable form in a particular milieu. The prevention of spontaneous heating is based on the preclusion of oxygen from the coal and the maintenance of an inert atmosphere within the stockpile. The method recommended for stockpiling is discussed and the tests for spontaneous heating as well as the quality of the atmosphere within the stockpile are described.

39102 **(VTT-TIED—825) Formation of nitrogen oxides in gasification and gas combustion. Literature review.** Leppaelahti, J. (Valtion Teknillinen Tutkimuskeskus, Espoo (Finland)). Jan 1988. 67p. (In Finnish). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88753769/JAW.

By gasifying a solid fuel and by cooling and purifying the gas, a clean fuel can be produced, the combustion of which results in environmental emissions of the same magnitude as those of natural gas However, significant amounts of nitrogen oxides can be formed in the combustion of raw gas or partially cleaned gas These oxides originate mainly from the nitrogen of the fuel. Different nitrogen compounds are developed from the fuel nitrogen in the gasifiers. There are carried as vapour through different hot gas clean-up devices. Hot clean-up of gas has been suggested to be applied in power plant concepts based on gasification and on combined-cycle power generation. The nitrogen oxide content of flue gases from the combustion of clean gas ranges 1-25 ppm in the combustion of high Btu gas and 30-280 ppm in the combustion of medium Btu gas. Nitrogen oxide contents of 400-1200 ppm have been measured for raw gas in the updraft gasification and combustion of biomass. The available reference values for the combustion of coal-derived gas range 130-300 ppm. The amount of nitrogen compounds in the gas varies depending on the gasification process applied. The most significant nitrogen compounds of the gas are NH/sub 3/ and HCN. The percentage of nitrogen bound in ammonia has ranged 10-60% of the nitrogen of the fuel in air gasification. The amount of hydrogen cyanide is normally about a tenth of nitrogen values, 1-4%. According to available measuring results, the percentage of ammonia in fluid-bed gasification has been 14-60%, depending on the process applied. In addition, the proportion of nitrogen bound in tar can be significant in biomass gasification. There is too little data available on the effect of gasification process parametres on the amount of nitrogen compounds.

39103 **Hydrology and geochemistry of surface coal mine lakes.** Schubert, J.P. (Argonne National Lab., IL (USA)). pp 402 of Mine drainage and surface mine reclamation. Volume I. Mine water and mine waste. Washington, DC; Department of the Interior (1988). (CONF-880413—).

From Annual meeting of the American Society for Surface Mining and Reclamation; Pittsburgh, PA, USA (17 Apr 1988).

Lakes are commonly created in surface-mined areas when mine pits or low depressional areas in spoil materials are not completely backfilled and eventually fill with water after mining operations have ceased. These lakes often contain good-quality water and have great potential post-mining benefits, such as swimming, boating, fishing, wildlife habitat, and even drinking water supplies.

Some lakes, however, are very acidic and contain deleterious concentrations of sulfate, iron, manganese, and other trace metals. A study was initiated in an attempt to determine the hydrologic and geochemical characteristics of mine sites that may be controlling water chemistry in the manmade lakes. Twenty-one lakes in the Eastern and Central US have been intensively sampled. Five lakes had pH values between 2.5 and 5.0, three lakes had pH values between 6.0 and 7.0, eight lakes were between 7.0 and 7.5, and five lakes had pH values greater than 7.5. Hydrologic variables such as infiltration rates, hydraulic conductivity, and texture of spoil materials have been measured. Geochemical analyses of soil, spoil, and lake bed samples included: pH, electrical conductance, cation exchange capacity, exchangeable cations, total sulfur, and neutralization potential. Multivariate statistical procedures have been utilized to determine which watershed characteristics, hydrologic variables, geochemical parameters, or lake morphometric variables are the most influential on the resulting water chemistry of mine lakes.

39104 **The federal clean coal technology demonstration program.** Miller, C.L. (Office of Clean Coal Technology, Dept. of Energy, Washington, DC (US)). pp vp. of Mining technology and policy issues. 1987. Washington, DC; American Mining Congress (1987). (CONF-870923—).

From Mining convention; San Francisco, CA, USA (13 Sep 1987).

The term "Clean Coal Technology" (CCT) has become an increasingly important part of our energy vocabulary. It has been defined in a generic sense as encompassing a variety of techniques for reducing SO/sub x/, NO/sub x/, and/or particulates. The technology may be designed to be retrofitted on older boilers without modification or be primarily intended for new powerplant construction. The technology may be able to achieve New Source Performance Standards fore one or more pollutants or achieve a more significant reduction in pollutant emissions. The technology may be projected to provide only a modes cost saving over current technology or a substantial reduction. Finally, the technology may require several more years of development or it may be ready for demonstration now. In the context of these numerous technical and economic parameters, virtually all of the Department of Energy's (DOE) Coal Research and Development (R and D) programs could be considered as constituting a Federal Clean Coal Program. As shown in Table 1, this program supported at a reported funding level approaching $1.5 billion for the 1981-1985 period and, in particular, the "Clean Coal R and D," which received over half of those funds (i.e. $678 million), has focused on new, innovative technologies that have the potential to remove sulfur oxides, nitrogen oxides, and particulate matter in greater amounts, more cost effectively, and in a more environmentally acceptable manner than today's state-of-the-art clean coal technology. However, it is not the authors' objective here to re-examine the reported efforts, concepts, and costs emerging from this R and D program. It is to introduce and discuss the status and initiatives of the important, associated, newly initiated, Federal Clean Coal Technology Demonstration Program.

0109 Environmental Aspects

REFER ALSO TO CITATION(S) 39103, 39127, 39599, 40007, 41157, 41242, 41255, 41309, 41321

39105 **(AD-A—191429/0/XAB) Baseline industrial-hygiene survey at the coal-fired heating plant, Malmstrom AFB, Montana. Final report.** Liebhaber, F.B.; Garg, K.B. (Air Force Occupational and Environmental Health Lab., Brooks AFB, TX (USA)). Dec 1987. 42p. (USAFOEHL—87-168EH0124MGA). NTIS, PC A03/MF A01.

This report documents the occupational-health conditions and exposures at the Malmstrom AFB MT coal-fired heating plant so a baseline industrial-hygiene monitoring program can be developed. Coal dust, ash, chemical, fugitive gas, noise, heat stress, and cold stress exposures were monitored. Results indicate the primary occupational health hazard was coal dust and ash exposure. This was especially true when the coal dust and ash silica content exceeded 5%. Hazardous noise levels were encountered throughout the plant. Potential chemical and heat/cold stress hazards were identified, but not considered significant at the time of the survey.

39106 (CONF-871075—Vol.1-Pt.1, pp 271-290) **Environmental experience and potential, using TVA's coal gasification facility.** Williamson, P.C.; Cox, D.B. (Tennessee Valley Authority (USA)). Oct 1987. NTIS, PC A15/MF A01. Order Number DE88007803/JAW.

From 3. Oak Ridge model conference on waste problems; Oak Ridge, TN, USA (13 Oct 1987).

During 1980 and 1985, TVA conducted a program in a 200-ton-per-day coal gasification facility to determine technical, economic, and environmental aspects of using coal to produce ammonia. This paper discusses the environmental findings of the study including the levels of materials of environmental concern in the gaseous, liquid, and solid discharges. Worker health and safety and fugitive emission in the workplace are discussed. The paper also presents a novel approach to destruction of hazardous and industrial wastes through the gasification process. In this concept, hazardous materials including polyaromatic compounds and chlorinated hydrocarbons are fed to the reactor, either with or independent of the normal coal feed, where decomposition takes place at elevated temperature in a reducing atmosphere. The design of the gasifier allows for feed of the material as an aqueous solution, and in some cases, as a sludge or a solid.

39107 **(DOE/PC/79796—T2) Enhancing the use of coals by gas reburning-sorbent injection: Quarterly report No. 3 for the period December 1, 1987-February 29, 1988.** (Energy and Environmental Research Corp., Irvine, CA (USA)). 15 Mar 1988. Contract FC22-87PC79796. 44p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88011163/JAW.

The objective of this project is to demonstrate gas reburning-sorbent injection (GR-SI) emission control technology on three pre-NSPS (National Environmental Policy Act) coal-fired utility boilers in Illinois. The goals are to achieve NO/sub x/ and SO/sub x/ emission reductions of 60 and 50% respectively. Work on Phase 1 of the program, Design and Permitting, commenced on June 5, 1987. During this quarter, work progressed on all tasks of this project, except Engineering Design, which awaits NEPA approval. Preliminary field tests have been carried out on the host units to obtain temperature and velocity measurements for comparison with heat transfer modeling and isothermal flow modeling simulations. The agreement between measurements and modeling varied with the boiler load. Overall, the results support the premise the isothermal flow modeling provides an adequate simulation of the flow field for the design of the reburn, burnout and sorbent injection systems. The progress in obtaining NEPA approval of the Environmental Information Volumes was delayed by the recognition that additional regulations must be satisfied. Each volume is being revised, with the first NEPA approval expected next quarter. The Environmental Monitoring Report Outline was submitted to the cofunders and DOE for their approval, and work on permitting design assistance to the host sites has been initiated. 9 figs.

39108 **(PB—88-865019/XAB) Acid mine drainage. October 1978-May 1988 (Citations from the NTIS data base). Report for October 1978-May 1988.** (National Technical Information Service, Springfield, VA (USA)). Jun 1988. 105p. NTIS PC N01/MF N01.

Supersedes PB—87-859039.

This bibliography contains citations concerning laboratory and field analyses of acid mine drainage. Topics include site investigations and characterization, renovation and monitoring programs, contaminant treatment research, and control and abatement studies. Chemical analyses of affected areas, and terrestrial and aquatic ecosystems response evaluations are also discussed. (This updated bibliography contains 190 citations, 10 of which are new entries to the previous edition.)

39109 **(UBA-FB—84-085) State-of-the-art of noise control measures in coal gasification and coal liquefaction plants.** Michelsen, R.; Stueber, B.; Lang, F. (Umweltbundesamt, Berlin (Germany, F.R.)). Dec 1986. 161p. (In German). Umweltbundesamt, Berlin (Germany, F.R.).

Umweltbundesamt - Texte.; no. 38/86.

Based on planning data for three coal gasification and liquefaction plants a description of the main sound sources in such plants is given. For these sources the dominant noise producing mecha-

nisms are described. Formulas are derived for the estimation of the noise produced by these sources with and without standard noise protection measures. For each of the three plants the total expected sound emission is estimated from technical data of the main sound sources under consideration of the sound protection measures according to the state-of-the-art. These theoretical considerations are verified by measurements taken at three pilot plants. Characteristic quantities such as A-weighted sound power levels referred to the plant capacity of the plant area have been derived as well as normalized average sound power spectra in octave bands for such plants. For complete plants with all noise control measures applied, the average sound power output from each square metre of the plant area yields a level of 62 dB(A) for coal liquefaction and 63 dB(A) for coal gasification plants. An approximate relation for the sound immission in the environment of modern plants is also described. (orig.) With 51 figs., 17 tabs., 56 refs.

39110 (VTT-TUTK—512) Emission measurements of energy production. Electrostatic classifier and its applications. Heiskanen, M.; Kauppinen, E.; Hahkala, M. (Valtion Teknillinen Tutkimuskeskus, Espoo (Finland)). Dec 1987. 61p. (In Finnish). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88753774/JAW.

The purpose of the study is to describe a measurement of the particle size distribution in the 0.01-1.0 μm diameter size range. The size distribution is measured by The Differential Mobility Particle Sizer (DMPS), in which the submicrometer particles are classified according to their electrical mobility. Electrical mobility is the function of the particle diameter and the number of elementary charges on the particle. The DMPS system uses a Condensation Nucleus Counter (CNC) as number concentration detector. A microcomputer performs the data inversion to obtain particle concentration as a function diameter. The volume (mass) distribution and the surface disctribution are obtained by assuming spherical particles and the density of particle 1 g/cm"3. In the study the size distributions of liquid DOP-particles and solid NaCl-particles are measured. The particles are generated by an atomizer. The electrostatic classification method provides a convenient sourse of monidisperse aerosol for instrument calibration. The median diameter of the polydisperse aerosol must match the monodisperse aerosol. The calibration of PALAS VKL 10-diluter was an application to use monodisperse aerosols. There are many different theories and experimental results of the bipolar charge distribution of particles in the size range below 0.1 μm. In the study the charge distribution of TSI's calculation program was changed and the effects of that change are discussed.

39111 (WGA—NRCC22858) Identification of the pollution potential of the harvesting and preutilization processing of peat as an energy commodity. Final report. (Washburn and Gillis Associates Ltd., Fredericton, New Brunswick (Canada)). Mar 1983. 75p. (CE—01537). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

The literature was reviewed to identify sources of environmental impacts resulting from the mining and pre-utilization of fuel peat in Canada and to identify possible methods to mitigate these impacts. Much of the information available from the literature applies to non-fuel uses of peat and is presented in a general manner because details are site specific. Dry mining of peat may result in increased levels of particulates and increased acidity. Particulate levels may be reduced through the use of settling ponds and through the design of drainage ditches so runoff will filter through peat before entering receiving waters. Increased acidity of drainage water may be reduced by treating wastewater in a manner similar to acid drainage from coal mines. Impacts of hydraulic mining of peat differ from those of dry mining techniques and are dependant on the method of dewatering. Wet carbonization and partial wet oxidation are methods proposed to break down the collodial structure of peat to facilitate mechanical dewatering. The wastewater treatment techniques recommended are a combination of anaerobic and aerobic treaments which aim to lower oxygen demand and remove organics. Information on waste streams from wet carbonization and partial wet oxidation is based on laboratory studies and pilot tests rather than full scale production operations. 64 refs., 3 figs., 5 tabs.

39112 Iron monosulfide and pyrite formation in sediments of lakes that receive acid mine drainage. Wicks, C.M.; Herman, J.S.; Mills, A.L.; Schubert, J.P. (Univ. of Virginia, Charlottesville (USA)). pp 402 of Mine drainage and surface mine reclamation. Volume I. Mine water and mine waste. Washington, DC; Department of the Interior (1988). (CONF-880413—).

From Annual meeting of the American Society for Surface Mining and Reclamation; Pittsburgh, PA, USA (17 Apr 1988).

Acid mine drainage can be ameliorated by the production of the minerals iron monosulfide (FeS) and pyrite (FeS_2) in impacted lake sediments. The authigenic formation of FeS_2 and FeS is hypothesized to occur when ferrous iron reacts with dissolved sulfide (H_2S, HS^-), which is produced by microbially mediated sulfate reduction. The result is that iron, sulfate, and acidity concentrations are decreased, while bicarbonate alkalinity is increased. As the iron concentration increases, the dry weight percent of FeS or FeS_2 in the sediments should increase. The objective of this study was to determine if pore water iron concentration could be used as an indicator of FeS and FeS_2 formation in the sediments. Samples of lake water, pore water, and sediment were taken from 14 lakes that receive AMD throughout the Appalachian, Eastern Interior, and Western Interior Coal Basins. Concentration ranges observed in the pore water samples were 0.1 to 1500 mg/L Fe^{2+}, 0.25 to 4.2 mg/L Fe^{3+}, 2.6 to 1850 mg/L SO_4^{2-}, and pH of 6.05 to 8.0. Values of Eh calculated from the ferrous-ferric redox couple showed oxic conditions existing in the pore water. The pore water composition, a reducing Eh, and field pH were used in the computer model PHREEQE to predict the saturation state of the pore water with respect to FeS_2 and FeS. Based on these results, in 9 of the 14 lakes pyrite is predicted to be the stable mineral phase. The remaining 5 lakes are significantly undersaturated with respect to pyrite. For each of these lakes, the reaction is limited by low concentrations of either iron or sulfur. Molar Fe/S ratios in FeS_2 and FeS are 1:2 and 1:1, respectively. All undersaturated waters exhibit extreme departures from these ratios.

39113 Zooplankton community responses to synthetic oil exposure. Hook, L.A.; Franco, P.J.; Giddings, J.M. (Data Analyst, Science Applications International Corp., Oak Ridge, TN (US)). pp 291-321 of Community toxicity testing. Cairns, J. Philadelphia, PA; ASTM (1986). (CONF-8505158—).

From ASTM symposium on community toxicity testing; Colorado Springs, CO, USA (6 May 1985).

While direct toxicant effects on populations can be estimated from single-species bioassay results, the complete range of population and community responses can best be investigated at the ecosystem level. The objectives of this research were (1) to determine the effects of a contaminant (a coal-derived light distillate oil on the zooplankton communities of laboratory pond microcosms and outdoor experimental ponds, (2) to compare responses of microcosm and field zooplankton communities with each other and with laboratory bioassay data, and (3) to explore the use of community structure data for impact detection. The responses of the microcosm and pond zooplankton communities to oil treatment were quite similar. Their close agreement lends support for using shallow-water pond microcosms as surrogates for field experiments in hazard evaluation. Changes in cladoceran densities were the most sensitive indicators of stress in the zooplankton communities. Copepods were slightly less sensitive, and rotifers were least sensitive to oil treatment. Indirect effects on populations were observed at intermediate treatment levels. The lowest treatment levels at which persistent and significant ecological changes occurred were the same in both systems. These levels were similar to the lowest observed-effect concentration (LOEC) for the Daphnia magna chronic bioassay, or approximately 3% of the D. magna 48-h LC.

0110 Reserves And Exploration

39114 (NP—8008627) [Bureau of Economic Geology]: Annual report, 1987. (Texas Univ., Austin (USA). Bureau of Economic Geology). 1987. 60p. Bureau of Economic Geology, Univ. of Texas at Austin, Austin, TX 78713. Order Number TI88008627/JAW.

Extensive advisory, technical, and informational services relating to the resources and geology of Texas are provided by the Bureau. In addition, the Bureau conducts basic and applied research projects in energy resources, mineral resources and statistics, coastal and environmental studies, land resources, geologic mapping, and a variety of other research programs in areas such as hydrogeology, basin analysis, and geochemistry. Some projects are conducted jointly with other units of the University as well as with State, Federal, and local agencies. The Texas Mining and Mineral Resources Research Institute is an administrative unit of the Bureau. The Annual Report of the Bureau of Economic Geology outlines the scope and status of current research projects, publications, personnel activities, and services in the area of Texas resources and geology that are available to governmental agencies, industry, and the public. 165 refs., 9 figs.

39115 (PB—88-182332/XAB) Stratigraphic correlations of the Seelyville, Dekoven, and Davis coals of Illinois, Indiana, and western Kentucky. Jacobson, R.J. (Illinois State Geological Survey, Champaign (USA)). 1987. 85p. (IL/SGS/CIRC—539). NTIS, PC A05/MF A01.

The Seelyville, Dekoven, and Davis Coals of Illinois, Indiana, and western Kentucky previously were considered separate coal seams of regional extent in the Illinois Basin Coal Field. Subsurface studies reveal that the Dekoven and Davis Coals are, in fact, splits of the Seelyville Coal. A series of seven linked cross sections, with an average of one well per mile, along a 170-mile northeasterly-trending transect in eastern Illinois, western Indiana, and western Kentucky links the type Seelyville Coal at its type area in west-central Indiana with the Davis (No. 6) and Dekoven (No. 7) coals at their type areas in western Kentucky. Geophysical logs constitute the bulk of data utilized in the cross sections. In its type area, the Seelyville Coal contains several shale partings, one of which is fairly continuous but ranges from less than one inch to more than 20 feet in thickness.

39116 (PB—88-182662/XAB) Hornsby District of low-sulfur Herrin coal in central Illinois (Christian, Macoupin, Montgomery, and Sangamon counties). Nelson, W.J.; DeMaris, P.J.; Bauer, R.A. (Illinois State Geological Survey, Champaign (USA)). 1987. 55p. (IL/SGS/CIRC—540). NTIS, PC A04/MF A01.

One of the largest deposits of low-sulfur coal in the Illinois Basin is in the so-called Hornsby District of Christian, Macoupin, and Montgomery Counties. An estimated resource of 1.17 billion tons of Herrin (No. 6) Coal, containing less than 2.5% sulfur, occurs here. Although the Hornsby deposit is thick, lies at moderate depth, and is close to market and labor supply, it has been barely touched by mining. The primary deterrent to mining this high-quality product has been fear of unstable roof conditions. Low-sulfur Hornsby coal contains about 1.5% less ash and 2% more moisture than does adjacent high-sulfur coal. The lower ash content probably reflects scarcity of pyrite. The reason for the difference in moisture content is unknown. High- and low-sulfur coal are nearly identical in heating value.

0120 Mining

REFER ALSO TO CITATION(S) 39124, 40618

39117 (MC—NRCC23016) An evaluation of alternative wet peat mining systems. (Monenco Consultants Ltd., Calgary, Alberta (Canada)). Sep 1983. 156p. (CE—01538). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

The objectives of this study were to review and assess the potential of wet peat mining systems for use in Canadian conditions, and to study mining systems involving excavation and transport of in-situ drained peat or removal of a 2 to 3% pumpable slurry (by other than cutter-suction dredging) in undrained peat. A technical assessment of the various mining methods and equipment was performed, and the compatibility with bog surface conditions (including weather) and with product end-use was determined. The application of peat slurry pipelines and pumping technology and the requirements (in terms of equipment design and mobility) for continuous or near-continuous operation on the bog surface were considered in detail. Transport systems and pumping aspects specifically related to peat were evaluated. Systems best suited to Canadian fuel peat production were selected. One new method suggested for small-scale applications is based on the use of an amphibious dredge. All of the equipment required for peat excavation and pumping is mounted on the amphibious machines. Another system, similar to the hydropeat mining method, is based on the use of modern technology and involves a special peat slurry pump mounted on a barge. A peat slurry is produced by hydro monitors and is pumped to the peat processing plant. The various systems described are designed for annual capacities ranging from 50,000 to 1,000,000 tonnes. 18 refs., 49 figs., 12 tabs.

39118 (NP—8770288) Investigations for a theoretical assessment of the cutting characteristics of cross-cutting heads and the stability of selective cutters. Mittmann, M. (Technische Univ. Clausthal, Clausthal-Zellerfeld (Germany, F.R.). Fakultaet fuer Bergbau, Huettenwesen und Maschinenwesen). 13 Jun 1986. 139p. (In German). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88770288/JAW.

As the fields of application of selective cutters are extending, more rigid requirements are being made on the machines, and especially on the cutting heads. The dissertation presents algorithms for calculating the forces acting on cross-cutting heads. The algorithms have been integrated in a computer-aided simulation program which can be run both on a theoretical basis and on the basis of measured data. The following aspects are discussed in detail: Parameters influencing the cross-cutting forces, theoretical determination of the forces acting on cross-cutting heads, preparation and implementation of the simulation calculation, results and analysis, further analysis, simulation results as a basis for stability calculations. For a given selective cutter with a cross-cutting head and with all parameters known, the author's method enables a detailed assessment of the cutting characteristics and smoothness of running of the cutting head as well as of the stability of the selective-cutting heading machine. (MOS).

0130 Transport And Handling

REFER ALSO TO CITATION(S) 39047

39119 (CRANZ-TP—31) Coal-heap sweep. (Coal Research Association of New Zealand, Wellington). Apr 1987. 4p. Coal Research Association of New Zealand, Wellington.

One of the least desirable features of industrial coal use, is the difficulty in storing the fuel and especially in conveying it to the point of use. In this first stage, the convenience of coal use compares badly with that of liquid and gaseous fuels which are supplied to the boiler by means of pipes. The ultimate dependence of New Zealand industry on coal, and the current economic advantage in the use of coal, justifies the expenditure of capital to facilitate the handling process, but care must be taken that high capital charges thus introduced, do not erode the economic advantage of the cheaper fuel. 4 figs.

0140 Combustion

REFER ALSO TO CITATION(S) 39057, 39092, 39099, 39612, 40702

39120 (DOE/METC—88/0256) Fluidized-bed combustion: Technology status report. (USDOE Morgantown Energy Technology Center, WV). Oct 1987. 70p. NTIS, PC A05/MF A01;1; GPO Dep. Order Number DE88001026/JAW.

This report describes the activities and accomplishments of the Morgantown Energy Technology Center (METC) research and development program in fluidized-bed combustion (FBC) from October 1, 1985, to September 30, 1987. The Department of Energy program involves two types of systems: atmospheric (AFBC) and pressurized (PFBC). This is the latest in a series of periodic reports that have described the AFBC (METC 1981, 1982a and b, 1984a),

PFBC (METC 1980, 1982c, 1984b), and combined (METC 1985a and 1985b) programs. This is the second report to discuss both programs in a single report. The scope of this report is limited to projects that are supported by the Department of Energy and does not cover all projects in the public and private sectors (Byam 1982). 40 refs., 22 figs., 2 tabs.

39121 (DOE/METC—88/4077) Continuum theories of granular materials with applications to fluidized beds: Technical note. Massoudi, M.; Boyle, E. (USDOE Morgantown Energy Technology Center, WV). May 1987. 89p. NTIS, PC A05/MF A01;1; GPO Dep. Order Number DE88001051/JAW.

In this report we discuss the development of the theory of continuous media as it is applied to granular materials. A historical perspective on the importance and everday use of granular materials in engineering applications is given, and various examples of what is meant by granular material are presented. In the first section, for future use and convenience, we introduce some basic definitions and fundamental concepts used in granular media. In the second section, which will be the core of this report, we discuss various continuum theories implemented for specific use of granular materials for different flow conditions. The end of this report reviews the existing constitutive equations for the solid phase in fluidized beds, and discusses the importance and relevance of modeling the solid phase as granular material. In Appendix A, similarities between continuum theories of granular materials and Korteweg's Theory of Capillarity are discussed. Appendix B presents a general class of constitutive relations, which imply a Mohr-Coulomb stress criterion for impending flow of material. In Appendix C, for brevity and simplicity, we present a summary of the constitutive equations for the stress tensor. And finally, Appendix D is a review of the continuum theories of liquid crystals and a discussion of the similarities between these theories and continuum theories for granular materials. 82 refs.

39122 (DOE/PC/79915—T1) Mechanisms of coal{endash}water mixture combustion in fluidized beds: Technical progress report, September 15, 1987{endash}December 15, 1987. Brown, R.C. (Iowa State Univ. of Science and Technology, Ames (USA)). 1987. Contract FG22-87PC79915. 6p. NTIS, PC A02/MF A01;1; GPO Dep. Order Number DE88009621/JAW.

Work in the first quarter of this project has included development of instrumentation, preparation of combustion apparatus, and acquisition of coal samples. Progress in each of these three areas is described.

39123 (DOE/PC/90505—T3) Mechanism of surface enrichment and adhesion of coal combustion particulates: Fourth quarterly report. Shadman, F.; Rizeq, R.G. (Arizona Univ., Tucson (USA). Dept. of Chemical Engineering). May 1988. Contract FG22-86PC90505. 27p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88012253/JAW.

The effect of alkali adsorption on the agglomeration of particles of bauxite, kaolinite, emathlite, lime and two types of coal ash is studied. An agglomeration (adhesion) temperature is defined which characterizes the adhesion propensity of particles. An experimental technique is developed to measure this agglomeration point in situ and without sample quenching or removal. The effect of alkali adsorption on the agglomeration characteristics of substrates is determined. The agglomeration temperature for all substrates decreases as alkali content increases. At low loadings the alkali adsorption enhances particle agglomeration by forming new compounds of lower melting points. At high concentrations, the agglomeration point of all substrates approaches the melting point of condensing alkali. Under these conditions, adhesion and agglomeration are caused by a layer of molten alkali which covers the exterior of the particles. 22 refs., 12 figs., 1 tab.

0150 Marketing And Economics

REFER ALSO TO CITATION(S) 39119, 40040, 40041, 40079

39124 (DOE/EIA—0121(87/4Q)) Quarterly coal report, October–December 1987. (USDOE Energy Information Administration, Washington, DC. Office of Coal, Nuclear, Electric and Alternate Fuels). 6 May 1988. 141p. NTIS, PC A07/MF A01 - GPO;1; GPO Dep. Order Number DE88010468/JAW.

For the US coal industry, 1987 was a noteworthy year. Both production and consumption reached record levels. The hot dry summer of 1987 was in large part reponsible for record coal consumption at electric utilities. Increased consumption in this sector accounted for almost the entire rise in total US coal consumption. The year ended with the highest third and fourth- quarter consumption totals ever recorded. Significant statistics for the year include the following: (1) Annual coal production rose to a record 916.9 million short tons, compared with 890.3 million short tons in 1986. (2) Coal receipts totaled 841.0 million short tons, including 721.1 million short tons received at electric utilities. (3) Coal consumption increased to 836.9 million short tons, surpassing 1986 consumption levels by more than 32 million short tons. (4) Producer and distributor stocks declined in each quarter of 1987, reaching 28.3 million short tons by year's end. The consumer stocks of 185.5 million short tons were over 10 million short tons higher than at the end of 1986, and over 20 million short tons higher than at the end of the third quarter. Consumpton rose at electric plants, but prices did not. By the fourth quarter of 1987, the average price of coal received at electric utilities was $31.16–the lowest average quarterly price since 1981. Coke imports nearly tripled in 1987 (compared with 1986) from 329 thousand short tons to 922 thousand short tons. Simultaneously, exports fell from 1.0 million short tons to nearly half as much–574 thousand short tons. (5) Coal exports dropped to the lowest level since 1983 (79.6 million tons in 1987), and imports were also down–1.7 million tons in 1987 compared with 2.2 million tons in 1986. 13 figs., 70 tabs.

39125 (DOE/PE/16037—T1) Recovery of regulatory costs for coal mine permitting: Final report. Eyruad, J.; Knight, L.; Boulding, R. (USDOE, Washington, DC; Eastern Research Group, Inc., Arlington, MA (USA)). May 1987. Contract AC01-84PE16037. 158p. NTIS, PC A08/MF A01; 1; GPO Dep. Order Number DE88012310/JAW.

In 1985 both the Office of Surface Mining (OSM) in the Department of the Interior and the General Accounting Office (GAO) proposed several options for implementing permit fees or coal production taxes to recover the cost of regulating coal mining. This report reviews the OSM and GAO cost recovery proposals (Section Two), analyzes coal production from 1980 to 1986 for trends relevant to these proposals (Section Three), examines the costs and activities by OSM and state agencies to regulate coal mining (Section Four), and evaluates fee/tax requirements and cost impacts on producers of regulatory cost recovery (Section Five). 54 tabs.

39126 (PB—88-205851/XAB) Coal industry outlook: a market perspective. Topical report. McMahan, R.L.; Knutson, K.S. (Resource Data International, Inc., Boulder, CO (USA)). Nov 1987. 226p. NTIS, PC A11/MF A01.

The study identifies the key issues most likely to influence the supply, demand, and transportation of coal over the next 25 years. These issues are analyzed from the perspective of the coal industry to produce a forecast for integration into Gas Research Institute's (GRI's) 1987 Baseline Energy Projection. The study examines the outlook for coal in terms of productivity, structure and strategies, and the changing business environment. A discussion on the health of the rail industry and the effects of competition sheds light on coal-transportation cost. Market issues and forecasts are provided for each of coal's major markets: electric utilities, industry/retail, metallurgical coke, and exports. Demand for coal by U.S. region is also provided. Part II of the study contains a complete set of supporting-data tables, an explanation of the methodology used in making the projections, and an assessment of the DRI coal modeling system previously utilized by GRI.

0160 Health And Safety

REFER ALSO TO CITATION(S) 41470

0170 Legislation And Regulations

39127 **(NBNRE—885) New Brunswick Crown peat resource management policy, 1979.** (New Brunswick Dept. of Natural Resources and Energy, Fredericton (Canada). Minerals and Energy Div.). 1988. 9p. (MICROLOG—88-02204). New Brunswick Dept. of Natural Resources and Energy, P.O. Box 6000, Fredericton, N.B., Canada E3B 5H1; $0.75 CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

This management policy deals with peat and peat moss on Crown lands in New Brunswick. Previous policy required such a low land leasing charge that operators within the peat industry were permitted to hold and under-utilize large tracts of Crown peatland. The new policy is intended to achieve the following objectives: ensuring that the resource makes a maximum contribution to the long-term economic development objectives of the province, simplicity of administration of tenure and collection of revenue, peat production from freehold as well as Crown land, and operation in a manner which will not jeopardize future utilization or rehabilitation. The policy as presented in this document outlines the criteria for eligibility to lease peatland, the documentation, surveys, and planning needed to obtain a lease, the term, size, and fees related to leases, and the royalties required to be paid based on quantity of production. A sample application is included.

02 PETROLEUM

REFER ALSO TO CITATION(S) 39046

0201 Reserves

REFER ALSO TO CITATION(S) 39134, 39159

39128 **(CMO—28101982) Response to the Lancaster Sound Regional Study Greeen Paper. The Lancaster Sound Region, 1980-2000.** (Consolidex Magnorth Oakwood, Calgary, Alberta (Canada)). 28 Oct 1982. vp. (CE—01331). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

The Consolidex Magnorth Oakwood (CMO) Lancaster Sound Joint Venture has reviewed the Green Paper issued by the Lancaster Sound Regional Study Group in July 1982. This response is made by CMO on behalf of a group of companies with interests in petroleum rights beneath the waters of Lancaster Sound. It is based on conclusions derived from the review and from related information acquired during the thirteen years that exploration rights in this region have been held. It describes the framework of a Resource Management Plan (RMP) with an exploratory well to be drilled in 1985. Projection of potential long term development, production and transportation activities, should commerical quantities of oil be found, are made. The RMP describes CMO's operating policies which are directed to balancing the rewards and burdens referred to earlier. These policies will be revised to incorporate further input from the public meetings of the Study Group taking place during the coming months. The appendices to this Response include historical information and bibliographies of the region. A review and bibliography of oil spill contingency research and technology are also included. 72 refs., 1 fig.

0202 Geology And Exploration

REFER ALSO TO CITATION(S) 39114, 39128, 39134, 41375

39129 **(GCR—1987) The northern challenge: the search for oil and gas in the Beaufort Sea and Mackenzie Delta.** (Gulf Canada Resources Ltd., Calgary, Alberta). 1987. 10p. (CE—01407). Gulf Canada Resources Limited, Investor and Public Affairs Division, PO Box 130, Calgary, Alta., Canada T2P 2H7; $N/C.

This report describes the oil and gas development activity in the Beaufort Sea and Mackenzie River Delta areas of Canada from the viewpoint of Gulf Canada Resources. Current discoveries and reserve potential are outlined and the environmental conditions of the region are briefly described. The history of exploration and drilling in the region is given, with the various offshore drilling and platform construction techniques put into historical perspective. Gulf's drilling system is then described, and its application to Beaufort Sea operations discussed. The development of the Amauligak offshore field is covered in some detail. Production is still in the future, and development of production facilities, transport systems, and logistical support are necessary. With satisfactory prices and the development of a Mackenzie Valley pipeline, it is envisoned that Amauligak will be economic by the mid 1990s. 16 figs.

39130 **(MEM—1987) Petroleum geology of the MC-3 Member, Mission Canyon Formation, Pierson area, southwestern Manitoba.** Husain, M.; Halabura, S.P. (Manitoba Ministry of Energy and Mines, Winnipeg (Canada)). 1987. 88p. (MICROLOG—88-02573). Manitoba Dept. of Energy and Mines, Legislative Bldg., Rm. 301, Winnipeg, Man., Canada R3C 0V8; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

The MC-3 Member comprises the uppermost portion of the Mission Canyon Formation in Manitoba. It represents a portion of one of the upper carborate-evaporite cycles in the Mississippian stratigraphic sequence of southwest Manitoba. The MC-3 Member consists of a sequence of lithofacies deposited on a shallow carbonate shelf. Six distinct lithofacies have been recognized in the Pierson study area and are described in this report. Reservoir rocks in the Pierson pools are primarily coated grain packstones to grainstones and non-coated grain packstones. Porosity is interparticle, moldic, and intercrystalline. Average reservoir porosity is 14% with average permeability of 10 to 12 millidarcies. The multiplicity of trap typers suggests that the Pierson and South Pierson Fields are a regional but discontinuous, hydrocarbon accumulation. All traps are primarily stratigraphic. Local traps, however, may occur where favourable reservoir facies are coincident with either paleotopographic highs or on the crest and flanks of true structural highs. From the previous analysis, it becomes apparent that some of the following conditions must be met in order to localize hydrocarbon accumulation within the regional trap formed by the truncation of the Mission Canyon Formation in the Pierson study area: presence of favourable reservoir rocks, and some form of updip and lateral seal development by dense, impermeable rocks (altered zone), and/or truncation of resrvoir rocks by the unconformity (erosion) surface. 33 refs., 21 figs.

39131 **(UCID—21396) Thermal front tracking with cross borehole electromagnetic imaging: Task 32 of Annex 4 of the implementing agreement.** Harben, P.E.; Pihlman, M. (Lawrence Livermore National Lab., CA (USA)). Apr 1988. Contract W-7405-ENG-48. 17p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88011756/JAW.

Field experiments at the Texaco Kern River Field were conducted to identify optimum transmission frequencies and assess the electromagnetic interference problems present in the system. We concluded that the transmitter must be operated below 3 MHz for attenuation measurements to be in the conduction regime. Operation in the conduction regime is necessary if we are to correlate images to independent measurements such as the dual induction logs. We also concluded that electromagnetic interference problems become more severe as the frequency is lowered. We are currently designing a downhole active transmitter that will operate at 2 MHz.

This frequency is low enough to be in the conduction regime and to increase our transmission distance capability, but high enough so that we can still drive a 1 or 2 meter antenna. By driving the antenna with a downhole oscillator we dramatically reduce the chance of electromagnetic interference pathways. Future plans are to test the transmitter at the Texaco field site and demonstrate correlation to induction logs. This will be followed by a brine tracing experiment at the same site. We will then move our equipment to a new pilot test site for a substantial series of cooperative experiments with Texaco. 5 refs., 11 figs.

39132 **Evaluation and comparison of residual oil saturation determination techniques.** Chang, M.M.; Maerefat, N.L.; Tomutsa, L.; Honarpour, M.M. (Natl. Inst. for Petroleum and Energy Research (US)). *SPE (Society of Petroleum Engineers) Formation Evaluation;* 3: No. 1, 251-262(Mar 1988).

The amount and distribution of residual oil saturation (ROS) are critical parameters for determining whether to apply an EOR process to a reservoir. A brief review of available ROS techniques is presented, indicating advantages, limitations, problems, and possible improvements of each technique. Advantages and disadvantages of each ROS-determination technique are summarized. Screening criteria for determining the best ROS technique under certain wellbore or reservoir conditions are presented. This paper also presents results from comparisons of ROS measurements obtained from the literature as calculated from resistivity logs, pulsed neutron capture (PNC) logs, pressure coring, single-well tracer tests, nuclear magnetism logs (NML), carbon/oxygen (C/O) logs, and electromagnetic propagation tool (EPT) measurements. In this study, the ROS measured by each method is compared with that determined by other methods conducted in the same well. The comparison shows that average values of ROS determined by C/O log, PNC-LIL (log-inject-log), and single-well tracer test do not differ statistically when compared with other methods. The resistivity log tends to give higher than average [2 saturation units (s.u.)] ROS measurements, while pressure coring tends to give lower than average (4 s.u.) ROS values. EPT and NML show deviations of about 8 s.u. of ROS values from other methods, which indicates a statistically significant difference. ROS vertical profiles obtained by two different methods from the same well were compared to eliminate the ROS variation resulting from formation depth. The vertical profiles based on ROS zoning and foot-by-foot measurements were studied to provide more "resolution" for comparisons.

39133 **A new analytic model for fracture-dominated reservoirs.** Karasaki, K.; Long, J.C.S.; Witherspoon, P.A. (Lawrence Berkeley Lab., CA (US)). *SPE (Society of Petroleum Engineers) Formation Evaluation;* 3: No. 1, 242-250(Mar 1988).

A new analytic model for analyzing well test data from fracture-dominated reservoirs is presented. It is a concentric composite model with a finite-radius well located in the center. In the inner region the flow is assumed to be linear, and in the outer region the flow is assumed to be radial. Solutions are obtained analytically and type curves for ranges of dimensionless parameters are presented. The model can be used to find the extent and the flow parameters of the fractures near the well and the average values for the entire system provided that wellbore-storage effects do not mask the early-time data.

0203 Drilling And Production

39134 **(DOE/FE/60600—T17-Exec.Summ.) Western Shallow Oil Zone, Elk Hills Field, Kern County, California: General Reservoir Study, Executive Summary: Bittium, Wilhelm, Gusher, and Calitroleum Sands.** Carey, K.B. (Evans, Carey and Crozier, Bakersfield, CA (USA)). 22 Dec 1987. Contract AC01-85FE60600. 388p. NTIS, PC A17;3. Order Number DE88007191/JAW.

The general Reservoir Study of the Western Shallow Oil Zone was prepared by Evans, Carey and Crozier as Task Assignment 009 with the United States Department of Energy. The study addresses the Bittium Wilhelm, Gusher, and Calitroleum Sands and their several sub units and pools. A total of twenty-eight (28) separate reservoir units have been identified and analyzed. Areally, these reservoirs are located in 31 separate sections of land including and lying northwest of sections 5G, 8G, and 32S, all in the Elk Hills Oil Fileds, Naval Petroleum Reserve No. 1, Kern County California. Vertically, the reservoirs occur as shallow as 2600 feet and as deep as 4400 feet. Underlying a composite productive area of about 8300 acres, the reservoirs originally contained an estimated 138,022,000 stock tank barrels of oil, and 85,000 MMCF of gas, 6300 MMCF of which occurred as free gas in the Bittium and W-1B Sands. Since original discovery in April 1919, a total of over 500 wells have been drilled into or through the zones, 120 of which were completed as Western Shallow Oil Zone producers. Currently, these wells are producing about 2452 barrels of oil per day, 1135 barrels of water per day and 5119 MCF of gas per day from the collective reservoirs. Basic pressure, production and assorted technical data were provided by the US Department of Energy staff at Elk Hills. These data were accepted as furnished with no attempt being made by Evans, Carey and Crozier for independent vertification. This study has successfully identified the size and location of all commercially productive pools in the Western Shallow Oil Zone. It has identified the petrophysical properties and the past productive performance of the reservoirs. Primary reserves have been determined and general means of enhancing future recovery have been suggested. 11 figs., 8 tabs.

39135 **(DOE/METC—88/4078) Validation of the one-dimensional compositional reservoir simulator (CRSIM-1D): Technical note.** Klara, S.M.; Holifield, T.F. (USDOE Morgantown Energy Technology Center, WV). Nov 1987. 67p. NTIS, PC A04/MF A01;1; GPO Dep. Order Number DE88001054/JAW.

The analysis presented in this manuscript validates the one-dimensional compositional reservoir simulator (CRSIM-1D). CRSIM-1D was developed at the Morgantown Energy Technology Center (METC), and is the first stage of an ongoing investigation of methods for increasing sweep efficiency of miscible EOR carbon dioxide (CO_2) floods. After its development, the simulator was validated to (1) ensure reliable predictions, (2) understand the sensitivity of input parameters, and (3) identify stability limitations of the code. The results from this study are presented in this report. The first part of this report summarized the results from the comparison of predictions from CRSIM-1D with both experimental data and the predictions from simulators. Four problems from the literature were examined: (1) 3-component oil displaced by a rich gas using single-point upstream weighting, (2) 3-component oil displaced by a rich gas using two-point upstream weighting, (3) 3-component oil displaced by a lean gas, and (4) 15-component oil displaced by CO_2. In all cases, the results from CRSIM-1D compare well with the results from the literature. Additionally, this report discusses the sensitivity of CRSIM-1D with regard to computational and physical variables. Sensitivities were evaluated for a wide range of physical variables (injection rate, porosity, etc.) and computational variables (time step size and grid size). Part of this evaluation compares CRSIM-1D's predictions to exact solutions that exist for simple problems such as incompressible immiscible floods. These comparisons should provide potential users with insight into the accuracy of predictions from CRSIM-1D. 18 refs., 15 tabs.

39136 **(GCR—1987) Gulf Canada Resources Limited Profile.** (Gulf Canada Resources Ltd., Calgary, Alberta). 1987. 29p. (CE—01385). Gulf Canada Resources Limited, Investor and Public Affairs Division, PO Box 130, Calgary, Alta., Canada T2P 2H7; $N/C.

This report presents an overview of Canada's major oil and gas companies, engaged principally in exploration, development, and marketing; it also has interests in gas processing plants, pipelines, oil sands, anthracite mining and overseas operations. Aside from corporate information, current operations are described in the following major areas: western Canada, the Hibernia field off the Newfoundland coast, the Beaufort Sea, Egypt, and the Mount Klappan coal field in British Columbia. Statistics (1982-#) on drilling, production, reserves, and land inventory are included. 24 figs., 6 tabs.

39137 **(NIPER—296) Preliminary results on the effect of fluid viscosity on three-phase relative permeability: Topical report, Project BE9, Task 1, Milestone 6, FY87.** Parmeswar, R.; Maerefat, N.L.; Brinkmeyer, A. (National Inst. for Petroleum and Energy Research, Bartlesville, OK (USA)). Feb 1988. Contract FC22-83FE60149. 11p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88008171/JAW.

Two- and three-phase relative permeability experiments were conducted on Berea sandstone cores for two systems. The first system used a 4.1-cp oil mixture, and the other system used a 47-cp oil mixture. The other two phases are nitrogen and brine. The steady-state method was used. End effects were eliminated by measuring pressures and saturations at the center portion of the core. The oil and brine saturations were determined by using the x-ray absorption and microwave absorption techniques, respectively. The gas saturation was determined by material balance. Accordingly with the literature, this is the first study ever reported on the effect of oil viscosity on three-phase relative permeability in a gas, oil brine system. Three-phase relative permeability results for the systems are presented and compared. The results show that the relative permeability to brine is a funciton of the brine saturation alone for both systems studied; increasing the oil viscosity lowered the relative permeability to brine by a factor of 10. The relative permeability to oil is a function of all three saturations, and the shapes of the oil isoperms are concave towards the 100 percent oil apex. The relative permeability to the high-viscosity oil seems to be less dependent on the gas and brine saturations than the relative permeability to low-viscosity oil. The gas relative permeability isoperms are concave toward the 100 percent gas apex, indicating that the relative permeability to gas is a funciton of all three saturations. However, comparison of the two isoperms for low- and high-viscosity oil systems reveals that the saturation of high-viscosity oil has more influence on the relative permeability to gas than the low-viscosity oil saturation does. 16 refs., 1 fig.

39138 **(OCS/MMS—87-0081) Offshore Scientific and Technical Publications: 1985 Annual.** Bajusz, A.M. (comp.). (Minerals Management Service, Vienna, VA (USA). Office of Offshore Information and Publications). 1988. 16p. Minerals Management Service, 1951 Kidwell Drive, Suite 601, Vienna, VA 22180. Order Number TI88012508/JAW.

The Minerals Management Service (MMS) established a scientific and technical publications program for Offshore Minerals Management in 1984. The objective of the program is to make the investigative findings of the Offshore Program available to the public. The Technical Publications Unit (TIP) within the Office of Offshore Information and Publications operates this program. The TPU has assigned series designations and publication numbers to scientific and technical documents issued by the Offshore Program since January 1, 1984. Documents are numbered consecutively within each calendar year.

39139 **(PRI—1983) Study of miscible gas flooding. First annual report. July 1982-March 1983.** Sayegh, S.G.; Fosti, J.E.; Najman, J.; Girard, M. (Petroleum Recovery Inst., Calgary, Alberta (Canada)). 1983. 118p. (CE—01662). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

This paper summarizes work on investigating waste process gases as miscible flooding agents, the mechanisms of oil recovery in miscible flooding, and guidelines for field application. Phase equilibrium and physical property data were measured for a number of mixtures using carbon dioxide, water, sulfur dioxide, and brine in various combinations. Solubility of the gases was investigated at pressures from 2 to 45 megapascals, and a 3-phase region was observed in the CO/sub 2//SO/sub 2//water system at 6.89 megapascals. Slim tube displacement tests were carried out using Pembina Cardium oil using carbon dioxide and sulfur dioxide in various combinations. All displacements were found to be miscible and showed the effectiveness of CO/sub 2//SO/sub 2/ mixtures as miscible enhanced oil recovery agents. Core floods were carried out to determine the effects of the flow of brines through Berea sandstone cores, using gas-free brines, brines with either carbon dioxide or sulfur dioxide, and one with sulfur dioxide-saturated water. The gas-free brines had a mixed effect on the cores, increasing their permeability in some cases and decreasing it in others. The runs carried out with the gas-saturated brines showed a decrease in permeability. 24 refs., 57 figs., 24 tabs.

39140 **(STF—75A87035) SUBCALC - A program for calculation of asymptotic availability of subsea oil/gas production systems.** Hokstad, P. (Elektrisitetsforsyningens Forskningsinstitutt, Trondheim (Norway)). Jan 1988. 23p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88753747/JAW.

This report describes a new computer code for reliability calculations of subsea oil/gas production systems. The approach is based on asymptotic agreements and will give approximate results for interesting availability parameters. The following topics are covered: The basic formula for calculating the asymptotic availability of a quite general concept is presented; A modification of the basic formula is introduced which will significantly increase the accuracy of the results; Conditions are given for when the asymptotic approach should be used. A computer code, SUBCALC, for carrying out the necessary calculations is described, and numerical examples are given, comparing results of SUBCALC and the simulation program SUBSIM. 5 refs., 6 figs., 2 tabs.

39141 **(STF—75A87044) SUBMARK - A Markov program for availability calculations of subsea oil/gas production systems.** Lindqvist, B.; Hokstad, P. (Elektrisitetsforsyningens Forskningsinstitutt, Trondheim (Norway)). Jan 1988. 23p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88753748/JAW.

This report describes a computer code (SUBMARK) for computing interesting reliability parameters of a subsea oil/gas production system. A general introduction to Markov modelling and computation of the asymptotic distribution is given. A Markov model for subsea oil/gas production systems is described, and numerical results of the Markov program, SUBMARK, are presented. These are compared with results of the programs SUBSIM and SUBCALC, earlier developed at SINTEF. 4 refs., 4 figs., 2 tabs.

39142 **Colored noise in dynamical systems.** Klosek-Dygas, M.M.; Matkowsky, B.J.; Schuss, Z. (Dept. of Mathematics, Univ. of California, Davis, CA (US)). *SIAM Journal on Applied Mathemadics;* **48**: No. 2, 425-441(Apr 1988).

The authors consider the problem of escape of a particle activated by small amplitude Gaussian colored noise, from a potential well. They consider various ranges of the parameters representing the bandwidth of the noise, its spectral height, and the dissipation coefficient. They employ singular perturbation methods to derive explicit analytical approximations for the stationary density of fluctuations about the deterministically meta-stable state at the bottom of the well, and for the mean first passage time to overcome the potential barrier and escape the well. The latter leads to a formula for the escape (activation) rate. Among other results the authors find that the mean first passage time is exponentially larger than in the white noise case.

39143 **Polymer floods: A case study of nonlinear wave analysis and of instability control in tertiary oil recovery.** Daripa, P.; Glimm, J.; Lindquist, B.; McBryan, O. (Dept. of Mathematics, Courant Institute of Mathematical Sciences, New York Univ., New York, NY (US)). *SIAM Journal on Applied Mathemadics;* **48**: No. 2, 353-373(Apr 1988).

Polymer flooding in oil reservoir simulation is considered in two space dimensions. The wave structures associated with such a process give rise to interesting phenomena in the nonlinear regime which have direct bearing on the efficiency of oil recovery. These waves influence and can prevent surface instabilities of the fingering mode. In this paper the authors resolve these waves by a front tracking method. They consider the fingering problem and the issue of oil recovery for the polymer flood. The details of these two phenomena depend on the separation between the waves and upon the viscosity contrast between the oil, water and polymer. They identify a nonlinear transfer of instability between adjacent waves and a nonlinear enhancement of recovery due to successive waves. The conclusions produced by this work are also pertinent to tracer flooding. One interesting conclusion applies to polymer injection

followed by pure water injection. In this case the instability is transferred to the polymer-water interface, and the pure water region can break through the polymer to achieve direct contact with the oil. The polymer is left in narrow ribbons parallel to the main flow field and is by-passed by pure water. The effect of narrow regions of by-passed polymer can be simulated by the front tracking method and is not equivalent to numerical or physical diffusion, which would distribute the polymer more uniformly and retard the breakthrough of water through the polymer layer.

39144 **Rock Creek oil field CO/sub 2/ pilot tests, Roane County, West Virginia.** Brummert, A.C.; Watts, R.J.; Boone, D.A.; Wasson, J.A. (U.S. DOE (US)). *Journal of Petroleum Technology;* **40**: No. 3, 339-347(Mar 1988).

This paper reports on the design and operation of two CO/sub 2/ EOR tests conducted in the Rock Creek field in Roane County, WV. The history, fluid properties, and geology of the Rock Creek field are presented first. The test area is then addressed more specifically with an evaluation of the cores and the geophysical logs of the injection, production, and observation wells. Finally, the injection history and the production response are documented. The first test was conducted in two 10-acre [4-ha], normal five-spot patterns, with 13,000 scf CO/sub 2//STB oil [2315 st m/sup 3// stock-tank m/sup 3/] injected. This test effort recovered 13,078 STB [2079 stock-tank m/sup 3/] of oil [3% of the original oil in place (OOIP)] but was terminated after 3 years before all oil capable of being mobilized was recovered. About 15% of an HCPV was injected. The first test was followed by a second, smaller test that, given the same amount of CO/sub 2/ to be purchased, would result in an increase in HCPV's of CO/sub 2/ injected and a greater potential for oil recovery. The second test was conducted in a 1.55-acre [0.63-ha], normal four-spot pattern contained within the original test pattern. This test lasted 2 years, with 9,000 scf CO/sub 2//STB oil [1603 std m/sup 3//stock-tank m/sup 3/] injected. Recovery from this test was 3,821 STB [607 stock-tank m/sup 3/] of oil (11% of the OOIP). About 48% of an HCPV was injected. It appears that CO/sub 2/ miscible flooding is technically successful in Appalachian reservoirs.

0204 Processing

REFER ALSO TO CITATION(S) 39172, 40605

39145 **(EMR—121987) Assessment of the potential for commercializaton of a low severity catalytic hydrogenation process for middle distillate upgrading. Final report.** (Department of Energy, Mines and Resources, Ottawa, Ontario (Canada)). Dec 1987. 91p. (MICROLOG—88-02163). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1. $0.34 CAN per page, $3.40 minimum; MF $10 CAN.

Possible mid 1990's specifications limiting the aromatic content of Canadian jet and diesel fuels will severely strain Canadian refiners. Increasing use of synthetic crude oils will worsen this problem. This study shows that a low severity hydrogenation process has possible commercial applications in both the short term (1992) and long term (2005). Extensive test work has been done with conventional high severity aromatic saturation catalysts and recently has been developing a low severity supported nickel catalyst route. The study compares these two routes for four feedstocks representing Canadian applications: two synthetic crude middle distillates, a blend of conventional crude diesel and light cycle oil from catalytic cracking and, light cycle oil. The study shows capital costs of both routes to be approximately equal, but not nickel catalyst route has marginally higher operating costs. At this time both process routes studied are still very expensive. The development of a sulphur tolerant nickel catalyst along with regenerability would greatly improve the economics of aromatic saturation generally. 124 refs., 8 figs., 24 tabs.

39146 **(IFP—35-514) Study of the hydrodynamics of fixed bed reactors with co-current gas and liquid upflow.** Barrios, Q. (Institut Francais du Petrole (IFP), 92 - Rueil-Malmaison). Feb 1987. 356p. (In French). NTIS (US Sales Only), PC A16. Order Number DE88752589/JAW.

The aim of the study is the improvement and development of hydrotreatment processes required by heavy petroleum. The influence of operating conditions and nature of the fluid or solid on flow regime, on fluids holdup and on bed pressure drop are examined experimentally with four types of solid (three different spherical porous alumina solids and a spherical non porous silica solid), two liquids (water or cyclohexane) and two gases (air or nitrogen). Depending on the flowrates of the fluids injected, five flow regimes are observed. The boundaries of these different hydrodynamic regimes depend on the size of the solid and on the nature of the liquid. However, under our experimental conditions, the column diameter did not seem to have a significant influence. A theoretical model of flow regimes is proposed. The experimental values for the pressure drop show clearly the influence of flowrates and the nature of fluid as well as the size of the particle. An empirical correlation, based on an energetic approach, allows to reproduce the experimental results with a relative error of 30%. For holdup of the fluids, a large effect of the nature of the solid is observed. The results of the macroscopic gas holdup are correlated using the concept of gas-liquid slip velocity. The average relative error is 28%. The role played by the nature of the solid, by the nature of the liquid and by the reactor size on the various hydrodynamic parameters is demonstrated. It will be necessary to undertake research on heat and mass transfer before being able to design a co-current upflow industrial reactor.

39147 **(MHGI—FED831) Incremental costs to the refining industry associated with the reduction in lead antiknock usage in gasoline.** (MHG International Ltd., Toronto, Ontario (Canada)). Dec 1981. 188p. (MICROLOG—88-02076). Environmental Protection Service, Environment Canada, 351 St. Joseph Blvd., Terrasses de la Chaudiere, Ottawa, Ont., Canada K1A 0E7; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

The principal objectives of this study were to define the extra processing capacity and to estimate the associated incremental capital and operating cost which Canadian refineries would incur if lead additive levels in motor gasoline were progressively reduced from 1979 levels to zero, while retaining the anti-knock quality. To reflect the different crude diets and product slates prevalent across Canada, refineries were segregated into four regions. A process simulator was used to compute the process parameters and models were developed representing the four regional composite refineries. It was deduced hypothetically that no capital investment would be required if 2 g and 1 g per imperial gallon lead level controls were imposed. To conform to a zero lead level control, the model indicates that significantly more processing capacity would be required in all regions. The approach adopted in the study was one whereby existing process unit capacity would be utilized to the best extent possible and as such, extra process units would be confined to catalytic reforming, virgin naphtha isomerization and alkylation. The associated incremental capital and operating costs have been estimated. Projected construction schedules have been developed and a staggered 4-5 year program is recommended. It is considered that there will be many opportunities for market specialization to alleviate some of the constraining parameters induced when lead-free gasoline is produced, notably by refineries specializing in premium gasoline and diesel fuel. Brief discussions are included in the report on future gasoline production to 1995, heavy oil refining, and technological progress to produce high octane gasoline without the use of lead anti-knock additives. 20 refs., 22 figs., 66 tabs.

39148 **(STA—101987) Fluid catalytic cracking of non-conventional gas oils by an octane-enhancing catalyst and a metals tolerant-catalyst.** (Sheridan Technical Associates, Inc., Mississauga, Ontario (Canada)). Oct 1987. 162p. (MICROLOG—88-01567). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1. $0.34 CAN per page, $3.40 minimum; MF $10 CAN.

This project attempts to establish the suitability of various gas oils as fluid catalytic cracking unit feedstocks and their performance when cracked over two different types of catalyst. The gas oil samples included a reference oil from conventional western Canada crude and gas oils from two heavy oils, a synthet', tar

sands crude oil, a shale oil and a primary upgraded product. The quality of the gas oils as feedstock ranged from good to poor as shown by the variation in composition and physical properties. Samples of Davison DA-440 and Nova D equilibrium catalysts were chosen as typical metals tolerant (REY) and octane enhancing (USY) catalyst. For each catalyst/feedstock combination, nine microactivity tests were completed operating at three temperatures and three C/O ratios. The results from the experimental program were used to assess the influence of feedstock composition and catalyst type on conversion and product selectivity. A kinetic model was further used in interpreting the data. The influence of feedstock composition on achievable conversion was demonstrated for five of the six feedstocks. In comparing the activity of the two catalysts, it was found that the Nova D catalyst gave higher maximum conversion for the reference crude, while the DA-440 catalyst gave a high maximum conversion for all the non-conventional gas oils. The products selectivity plots - product yield vs conversion - showed that the two catalysts were similar. This report's combination of microactivity test results and feedstock and catalyst characterization provides a basis for evaluation of a range of gas oils and catalysts. 29 refs., 90 figs., 28 tabs.

39149 **(STU—81-4547) Thermogravimetric study of bastnaesite under simulated SO/sub x/ transfer conditions.** Andersson, S. (Swedish National Board for Technical Development, Stockholm). 24 Jul 1986. 9p. (In Swedish). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88753749/JAW.

One way of reducing sulphur oxide (SO/sub x/) emissions from Fluidized Catalytic Cracking (FCC) units is to admix an SO/sub x/ transfer catalyst with the FCC-catalyst. A basic understanding of the SO/sub x/ transfer mechanism is needed if optimal SO/sub x/ transfer conditions are to be found. With the aid of thermogravimetry the reactions of bastnaesite, essentially a mixture of rare earth element fluorocarbonates, during SO/sub x/ transfer were studied to determine its properties as a potential SO/sub x/ transfer catalyst. The fast absorption of SO/sub 2/ in air at 700/sup o/C gives a rare earth sulphate compound. However, much of the cerium (III) is oxidized during absorption and CeO/sub 2/ is formed which is not active in SO/sub x/ transfer. H/sub 2/S is the important gaseous species in the slow regeneration of the SO/sub x/ transfer catalyst. The regeneration has been found to involve the formation of gaseous sulphur and an oxosulphate. The oxosulphate is considered to be the active SO/sub 2/ absorbing compound during SO/sub x/ transfer. According to the thermogravimetric measurements the rate of regeneration reaches a maximum when approximately one third of the SO/sub 2/ absorbing capacity has been utilized. Increased H/sub 2/S partial pressure, higher temperature and longer solids residence time in the (reactor)/stripper, are other factors that should increase the conversion of sulphate to sulphur and oxosulphate. (authors).

0205 Products And By-products

REFER ALSO TO CITATION(S) 39089, 41155

39150 **(AD-A—191313/6/XAB) Development of a laboratory test for multiport fuel-injector deposits - evaluation of the Jet Fuel Thermal Oxidation Test Apparatus (JFTOT). Final report.** Strange, H.O. (Coordinating Research Council, Inc., Atlanta, GA (USA)). Dec 1987. 39p. NTIS, PC A03/MF A01.

This report describes the laboratory effort to develop a bench test suitable for screening gasolines to determine their potential for forming deposits in automotive port fuel injectors. The test selected for this work was the Jet Fuel Thermal Oxidation Test (JFTOT) method described in ASTM D 3241. Tests were conducted at various temperatures and operating conditions on two base gasolines having low and high deposit-forming tendency in vehicle tests. In addition, tests were also run on a commercial unleaded gasoline containing detergent additives and on the high-deposition fuel treated with varying dosages of four additives claimed to be effective in preventing port fuel-injector deposits in vehicle tests.

39151 **(AD-A—191717/8/XAB) Reference filters for electrostatic-charging tendency measurements of fuels. Final report, July 1986-June 1987.** Affens, W.A. (Geo-Centers, Inc., Newton Upper Falls, MA (USA)). Sep 1987. 36p. (GC-TR—87-1628-F). NTIS, PC A03/MF A01.

A study was made to determine whether laboratory filter papers might be suitable as reference filters for the determination of charging tendencies of jet fuels as measured in the EXXON Mini-Static Tester (MST). From the filter papers investigated, it was concluded that, compared to commercial fuel filters, these filters do not generate enough charge to afford repeatable and reliable measurements. Some correlation was observed between the polarity of the generated charges and the nature of the filter-paper surfaces. However, attempts to repeat these experiments after a time period of about six to eight months were unsuccessful because of variations in the data, particularly that of polarity of the charge. It is suggested that the variations may have been due to relative humidity and temperature changes in the laboratory over the time period. Another possible explanation might be that there were changes in fuel composition due to degradation. A few studies of some ion-exchange-resin coated filter papers suggest some tentative generalizations regarding these papers. It was observed that the flow rate of fuel through each type of filter was not constant for any given run. Since it was necessary to have accurate flow rate data for each filter in order to be able to calculate charging tendency from the measured streaming current, a method was devised to make this measurement.

39152 **(EPS—IP76) Diesel fuel quality effect. Status report.** Ostrouchov, N. (Environnement Canada, Ottawa, Ontario. Conservation et Protection). Dec 1987. 17p. (MICROLOG—88-02066). Environmental Protection Directorate, Environment Canada, 351 St. Joseph Blvd., Terrasses de la Chaudiere, Ottawa, Ont., Canada K1A 0E7; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

This report reviews the published literature concerning fuel effect on diesel particulate emissions. The effects and the costs of reducing particulate emissions by means of changes in diesel fuel composition are represented. Two specific changes were considered: a drastic reduction in diesel fuel sulfur content, and/or a moderate reduction in the aromatic hydrocarbon content. Canadian activitiese currently underway are discussed. Very little information exists in the literature on the effects of diesel fuel composition on either gaseous or particulate emissions, primarily because of the lack of investigations of sulfur, aromatics, and 90 percent distillation point as an independent fuel variables. In addition the sensitivities of emissions to fuel composition observed in available studies were derived from steady-state, modified US EPA transient testing and standard US EPA transient testing, making comparison very difficult. An attempt was made to compare the effect of fuel sulfur content on particulate emissions, derived from four independent studies. The comparison indicates that reducing fuel sulfur content below 0.10 wt% may reduce directly emitted particulates mass below proposed 1991 standard without aftertreatment technology. The data also indicate, however, that extensive engine modification may reduce particulate emissions below 1991 standards without reducing fuel sulfur content and without using an aftertreatment technolgy. However, caution should be exercised in interpreting the data, because different test procedures and different or unknown fuel aromatics contents were used by different researchers. 13 refs., 1 fig., 2 tabs.

39153 **(PB—88-188271/XAB) Field and laboratory study of cold-asphalt-mix recycling in Ohio. Final report.** Majidzadeh, K.; Ilves, G.J.; Abdulshafi, A.; Kaloush, K. (Resource International, Inc., Columbus, OH (USA)). Sep 1987. 121p. NTIS, PC A06/MF A01.

The report presents a study initiated in 1984 to develop specification guidelines and mix-design recommendations and to obtain performance data on cold-mix recycling projects in Ohio. Two mainline, low-volume roads and one shoulder pavement were selected for the study. Documentation and evaluation of the projects are discussed generally in two parts. The first part includes the site-

selection criteria, pre-construction evaluation, mix designs, construction specifications and construction monitoring. The second part discusses performance evaluation through field inspection, data collection, and laboratory evaluation of material properties.

0206 Health And Safety

39154 **(STF—21A85027) Toxicity tests of ten drilling fluids measured by the Beckman Microtox method.** Halmoe, G. (SINTEF, Trondheim (Norway)). Feb 1985. 14p. NTIS (US Sales Only), PC A03. Order Number DE88753741/JAW.

This report describes the test procedures and the results of the toxicity testing of ten drilling fluids. The total report includes the introduction and summary/joint discussion of the results. 1 drawings, 6 tables.

39155 **(STF—75A87014) Critical situations in offshore production.** Bodsberg, L. (SINTEF, Trondheim (Norway)). May 1987. 19p. (CONF-8704307—1). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88753744/JAW.

From Seminar in crisis management; Oslo, Norway (1 Apr 1987).

The results of a survey of alarm and shutdown frequencies in offshore production are presented. Nearly 1300 daily activity reports submitted by oil companies to the Norwegian Petroleum Directorate in 1984 have been reviewed. Estimates are given for the frequency of hazardous situations as well as the frequency of false alarms and spurious process shutdowns. Furthermore, the main types of hazardous situations and safety equipment faults are presented together with the systems involved. 2 refs., 7 figs., 4 tabs.

0207 Marketing And Economics

REFER ALSO TO CITATION(S) 39190, 39995, 40003, 40040, 40041, 40051, 40052, 40079

39156 **(AE/P—101987) Alberta petroleum industry activity and oil economics. Status report.** (Alberta Energy, Edmonton (Canada). Petroleum Div.). Oct 1987. 9p. (MICROLOG—88-01947). Alberta Dept. of Energy, Petroleum Plaza Twr., 9915-108 St., Edmonton, Alta., Canada T5K 2C9; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

This report, largely in graphic form, presents the following information on current petroleum industry activity in Alberta: number of oil and gas parcels requested for public tender and their average price, number of drilling rigs, capital raised by oil and gas companies in Canada, changes in federal and provincial oil/gas fiscal systems since 1985, Alberta crude oil producer netbacks, maps showing major oil play economics and intensive oil and gas activity, heavy oil and in-situ bitumen production, and project costs. 10 figs.

39157 **(BR—1986) Bralone Resources Limited annual report, 1986.** (Bralorne Resources Ltd., Calgary, Alberta (Canada)). 1986. 24p. (CE—01446). Bralorne Resources Limited, 3100 205-5th. Avenue, S.W., Calgary, Alta., Canada T2P 2V7; $N/C.

Bralorne Resources Limited is a diversified North American energy company headquartered in Calgary, Alberta, with plants in Canada and the United States. The Company explores for and produces oil and natural gas in western Canada. It also manufactures and supplies products such as drilling and exploration equipment as well as services to energy-related industries world-wide. This report reviews the year's activities of the company and its subsidiaries. Financial statements are also included.

39158 **(BR—1987) Bralorne Resources Limited annual report, 1987.** (Bralorne Resources Ltd., Calgary, Alberta (Canada)). 1987. 24p. (CE—01447). Bralorne Resources Limited, 3100 205-5th. Avenue, S.W., Calgary, Alta., Canada T2P 2V7; $N/C.

Bralorne Resources Limited is a diversified North American energy company headquartered in Calgary, Alberta, with plants in Canada and the United States. The Company explores for and produces oil and natural gas in western Canada. It also manufactures and supplies products such as drilling and exploration equipment as well as services to energy-related industries world-wide. This report reviews the year's activities of the company and its subsidiaries. Financial statements are also included.

39159 **(CERI—25) An evaluation of crude oil supply in Saskatchewan.** Tanner, J.N. (Canadian Energy Research Institute, Calgary, Alberta). Dec 1987. 153p. (MICROLOG—88-02039). Canadian Energy Research Institute, 3512-33rd St. NW, Calgary, Alta., Canada T2L 2A6; $30.00 CAN.

This study focuses on the likely implication of crude oil price volatility on future oil supply from Saskatchewan. Currently, this supply is measured by the amount of remaining established reserves. If prices were to change drastically, the amount of reserves which could actually be recovered may be substantially different. This study constructed a model to help analyze the effects of price changes on established reserves, and also reserves additions from both new discoveries and extensions of older pools. The model employs the Saskatchewan government well data base and research on the royalty rates, taxes, and operation costs. The results show that the short-run supply of crude oil, defined as supply without further exploration or development, does not change dramatically unless prices fall well below $10/bbl. The model was run over a 19-year period to obtain these results. If the base case were run for a longer period, the added production would approximate the added reserves estimate. However, if prices were to fall to the lower price forecast for an indefinite period, up to 20 million cubic meters of established reserves could be lost. The long-run analysis includes both current established reserves and those likely to be discovered in the future; an interesting result of this section of the study is that most future reserves additions are likely to come from extensions of already-discovered pools. 22 refs., 9 figs., 30 tabs.

39160 **(DOE/EI/19925—T1) Prices/stocks of No. 2 heating oil, state of Oregon, 1986-1987: End of survey report.** (Oregon State Dept. of Energy, Salem (USA)). 1987. Contract FC01-86EI19925. 34p. NTIS, PC A03;3. Order Number DE88011612/JAW.

Residential and Rack prices for number two (#2 Diesel) Heating Oil and Stock-in-Inventory data was collected from 1 October 1986 through 04 May 1987 in accordance with the contract schedule. A one time survey was conducted to determine discount prices for cash and early payment given by dealers. This information was routinely reconfirmed throughout the period of the survey - reported changes were forwarded to the appropriate personnel. No other data were collected on a regular basis during the course of the survey. However, additional information dealing with respondent dealership problems, shifts in ownership, and major oil company policies were provided to other authorized recipients when requested. 1 fig., 2 tabs.

39161 **(DOE/EI/19925—T2) Prices/stocks of No. 2 heating oil, State of Oregon, 1986-1987: End of survey report.** (Computer Resource Application Group, Portland, OR (USA)). 1987. Contract FC01-86EI19925. 28p. NTIS, PC A03. Order Number DE88012165/JAW.

Residential and Rack prices for number two ({number←sign}2 Diesel) Heating Oil and Stock-in-Inventory data was collected from 1 October 1986 through 4 May 1987 in accordance with the contract schedule (See Appendix A). A one time survey was conducted to determine discount prices for cash and early payment given by dealers. This information was routinely reconfirmed throughout the period of the survey---reported changes were forwarded to the appropriate personnel. No other data was collected on a regular basis during the course of the survey. However, additional information dealing with respondent dealership problems, shifts in ownership, and major oil company policies were gathered and passed on with the submitted reports or were provided to other authorized recipients when requested. 12 figs., 2 tabs.

39162 (DOE/EI/20471—T1) Massachusetts Executive Office of Energy Resources: No. 2 home heating oil program, 1987/88: Final report. (Massachusetts Executive Office of Energy Resources, Boston (USA)). 1988. Contract FC01-87EI20471. 16p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88011188/JAW.

This final report summarizes the results from the price and inventory surveys conducted in Massachusetts over the 1987/88 heating season. Factors which influenced these results are also discussed.

39163 (GCR—1987) Gulf Canada Resources Limited annual report, 1987. (Gulf Canada Resources Ltd., Calgary, Alberta). 1987. 45p. (CE—01388). Gulf Canada Resources Limited, Investor and Public Affairs Division, PO Box 130, Calgary, Alta., Canada T2P 2H7; $N/C.

Gulf Canada Resources is a leading explorer and producer of oil and natural gas in Canada, with activity in western Canada, the Beaufort Sea, and off the Newfoundland coast. It also operates gas processing plants and pipelines, participates in oil sands projects and overseas oil exploration and owns an anthracite deposit in British Columbia. This report presents a review of the company's activities. Operations in western Canada, frontier, international, and coal mining areas are described, and consolidated financial statements, with associated information, are presented.

39164 (GULF/B—1986) Gulf Canada Corporations annual report, 1986. (Gulf Canada Corp., Burlington, Ontario. Research and Development Dept.). 1986. 66p. (CE—01359). Gulf Canada Resources Limited, Investor and Public Affairs Division, PO Box 130, Calgary, Alta., Canada T2P 2H7; $N/C.

This report outlines the business activities and provides financial data of Gulf Canada, which currently operates in five principal areas: the exploration and development of oil and gas properties through its oil and gas division Gulf Canada Resources; the forest products industry through its 83% interest in Abitibi-Price Inc.; natural gas distribution through its 83% interest in The Consumers' Gas Company Ltd.; the distilled spirits business through its 49% interest in Hiram Walker-Gooderham & Worts Limited; and the operation of pipelines in North America through its 41% interest in Interprovincial Pipe Line Limited (IPL). IPL also owns 100% of Home Oil Company Limited which carries on an oil and gas business, principally in Canada.

39165 (NCO—1986) North Canadian Oils Limited annual report, 1986. (North Canadian Oils Ltd., Calgary, Alberta). 1986. 33p. (CE—01443). North Canadian Oils Limited, Sun Life Plaza III, Ste. 700, 112 Fourth Ave., S.W., Calgary, Alta., Canada T2P 4B2; $N/C.

North Canadian Oils Limited is an oil and gas exploration and development company whose activities are primarily concentrated in the Western Canadian Sedimentary Basin. The company is also involved in the mining of lead and zinc through its 87% owned subsidiary, Bankeno Resources Limited. This report highlights the year's activity in exploration, production, and marketing, with relevant data presented. Financial statments are also included.

39166 (PB—88-928600/XAB) International Energy Statistical Review. Monthly report. (Central Intelligence Agency, Washington, DC (USA)). 1988. vp. NTIS Subscription.

Supersedes PB—87-928600; Paper copy available on subscription, North American Continent price $65.00/year; all others write for quote. Also available in single copies.

International Energy Statistical Review presents economic and statistical information on International oil production, oil consumption, oil imports and exports, crude oil production, natural gas production, storage imports, and exports. It also deals in the areas of oil and natural gas trade, oil stocks, oil spot market price, retail petroleum product prices, and crude oil prices. There are approximately 30 pages per monthly issue.

39167 (PW—1987) [Canada] Oil and gas survey, 1987. (Price Waterhouse, Toronto, Ontario (Canada)). 1987. 57p. (CE—01764). Price Waterhouse, 1200, 425-1st St. S.W., Calgary, Alta., Canada T2P 3V7; $N/C.

This summarizes the financial reporting of a major segment of the oil and gas industry in Canada as shown in annual reports to shareholders for 1986. Annual reports have been surveyed with particular attention to developments in accounting practices in the oil and gas industry during 1986. The survey was not restricted to financial statements and all information presented in the annual reports was considered. Matters of general financial disclosure not unique to the oil and gas industry are not included. Examples quoted from reports covered by this survey are not presented as recommended methods but are illustrations of present practice only. Some illustrations were drawn from oil and gas companies not included in the survey.

39168 (VTT-TUTK—406) Influence in the car taxation system. Alppivuori, K.; Kallberg, H.; Pekki, M. (Valtion Teknillinen Tutkimuskeskus, Espoo (Finland)). Jun 1986. 74p. (In Finnish). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88753763/JAW.

In Finland the car prices are exeptionally high due to car taxes included in the new car prices. The gasoline price, which is at international leve, includes also taxes. The aim of this study was to calculate the effects of reducing the car taxes and correspondingly rising fuel taxes so that the state income car taxation does not change. The study was performed in two stages: an interview and a simulation study. The interview was aimed at the general public (postal poll) and at experts in car trade (personal interview). The aim was to reveal the parameters in the economic models explaining the behaviour of the public in car purchasing and car use. The simulation study was performed to calculate quantitative changes in, e.g. car park, traffic volumes and energy consumption caused by supposed changes in the taxation. One of the main results was that unchanged taxation is leading to rapidly increasing traffic volumes and total taxes for car use.

39169 (ORNL/tr—88/6) The structure and policy of petroleum pricing in Korea. Lee, Hoe Sung. (Korean Inst. of Energy and Resources, Seoul (Republic of Korea)). 1988. Contract AC05-84OR21400. Translation source information not available. 37p. NTIS, PC A03/MF A01;1.

This report discusses the government's pricing of petroleum products in Korea. The economics associated with supply and demand national market prices, and spot market prices have been investigated. Problems in the structure and policy of petroleum pricing are examined and conclusions are drawn as to the role of the government in the market functions.

0208 Waste Management

REFER ALSO TO CITATION(S) 39149, 39233, 40093, 40757

39170 (PB—88-186077/XAB) Underground storage tank disposal: alternatives, economics, and environmental costs. Robinson, J.E.; Scott, D.W.; Knocke, W.R.; Conn, W.D. (Virginia Polytechnic Inst. and State Univ., Blacksburg (USA). Virginia Water Resources Research Center). Feb 1988. 57p. (VPI-VWRRC-Bull—160). NTIS, PC A04/MF A01.

See also PB—88-186127.

Alternative technologies are examined for the disposal of disused underground storage tanks (UST) that once contained petroleum products or other hazardous chemicals and the effects of hazardous-waste laws on disposal are discussed. Disposal options for the large population of old vessels are considered in terms of currently required and available technologies, the benefits and problems associated with various strategies, and the means available to a tankowner for utilizing these options through either a full or partial contracting of commercial services. Actual disposal costs charged by firms offering the service in or near Virginia are compared, and the environmental impacts associated with cleaning wastes and tanks discharged according to each strategy are addressed. Addi-

tional information about pertinent regulations and the characteristics of the national UST populations are provided in the Appendices.

39171 **(PB—88-186127/XAB) Financial-responsibility provisions for underground-storage tanks in Virginia.** Thompson, P.S.; Conn, W.D.; Geyer, L.L. (Virginia Polytechnic Inst. and State Univ., Blacksburg (USA). Virginia Water Resources Research Center). Feb 1988. 43p. (VPI-VWRRC-Bull—161). NTIS, PC A03/MF A01.

See also PB—88-186077.

Under the provisions of recent federal and state legislation, the owners and operators of underground storage tanks containing petroleum products are required to maintain evidence of financial responsibility. The requirements as they presently stand, different ways of meeting them, and associated issues are examined. The regulated community is described as well as proposed financial responsibility regulations under RCRA Title 1, their relevance to the situation in Virginia and to any state regulatory initiatives, and a suggested set of criteria for judging these initiatives. The next section describes allowable financial responsibility assurance mechanisms, and reviews the advantages and disadvantages associated with each. A critique follows of financial responsibility legislation recently enacted in Virginia. Conclusions and recommendations are intended to assist state decision makers in designing and implementing an effective set of financial responsibility regulations for underground storage tanks.

39172 **(PB—88-195243/XAB) Thin-film evaporation as a pretreatment technique for removing volatile organics from petroleum-refinery wastes.** Northeim, C.M.; Allen, C.C.; Westfall, B.A. (Research Triangle Inst., Research Triangle Park, NC (USA)). Apr 1988. 17p. NTIS, PC A03/MF A01.

Oily wastes from petroleum refineries can result in air emissions during the land treatment of these wastes. A pilot-scale thin-film evaporator (TFE) was used to remove volatile organics (VO) from refinery tank-bottom sludge. Different TFE operating parameters were utilized to determine optimum process operating conditions and the percent removal of specific VO compounds was measured. Removal efficiencies of up to 99.9% were obtained, resulting in a 95% reduction in VO emissions from a land treatment test plot.

39173 **An integrated process for simultaneous desulfurization, dehydration, and recovery of hydrocarbon liquids from natural gas streams.** Sciamanna, S.F.; Lynn, S. (Dept. of Chemical Engineering, Univ. of California, Berkeley, CA (US)). *Industrial and Engineering Chemistry Research;* **27**: No. 3, 500-505(Mar 1988).

Conventional processing schemes for desulfurizing, drying, and separating natural gas liquids from natural gas streams require treating the gas by a different process for each separation step. In a simpler process, based on the University of California, Berkeley, Sulfur Recovery Process (UCBSRP) technology, hydrogen sulfide, propane and heavier hydrocarbons and water are absorbed simultaneously by a pol(glycol ether) solvent containing a homogenous liquid-phase catalyst. The catalyst promotes the subsequent reaction of hydrogen sulfide with added sulfur dioxide to produce a high-quality sulfur product. Hydrocarbons are separated as two product streams with the split between propane and butane. This new process offers an overall reduction in both capital and energy costs.

0209 Environmental Aspects

REFER ALSO TO CITATION(S) 39110, 39128, 39138, 39189, 39198, 41303, 41304, 41305, 41306, 41339, 41340, 41341, 41342, 41343, 41344, 41345, 41346, 41357

39174 **(C—EE94) Laboratory and tank test evaluation of Elastol.** Bobra, M.A.; Kawamura, P.I.; Fingas, M.; Velicogna, D. (Consulthem, Ottawa, Ontario (Canada); Environment Canada, Ottawa, Ontario). Dec 1987. 108p. (MICROLOG—88-02060). Environmental Protection Directorate, Environment Canada, 351 St. Joseph Blvd., Terrasses de la Chaudiere, Ottawa, Ont., Canada K1A 0E7; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

This study was conducted to determine the performance of a new spill treating agent called Elastol. When applied to oil, Elastol imparts a viscoelastic property which improves the efficiency of oil spill cleanup. This study focused on the effect of Elastol on selected oil properties and physical processes to which oil slicks are subjected. Experiments were performed in three stages: small-scale laboratory experiments, followed by small, and then large scale wave generating tank tests. The tests showed that eight different crude oils as well as diesel exhibited a viscoelastic property when treated with 600 to 6000 ppm of Elastol. In a separate experiment, it was found that the addition of Elastol reduced the extent of spreading. Treated oils also exhibited a slightly lower rate of evaporation but no change in the flash point was observed. Emulsion studies showed that of the ten oils tested, two exhibited increased emulsion formation tendencies when treated with Elastol while two showed a marked decrease. For the other oils that emulsified, the addition of Elastol lowered the emulsion water content. In the small-scale tank tests, the addition of 6000 ppm of Elastol imparted significant elasticity to the oils tested. Oil slicks treated with Elastol showed a lower degree of emulsification, dispersion, and viscosity increase. The results from the preliminary large-scale tank tests confirmed the basic trends and results observed in the laboratory testing of Elastol. Moderate wave energy appeared to enhance and speed up the elasticity sufficiently to allow for burning, and the skimmer recovered 93% of the spilled oil. 14 refs., 57 figs., 5 tabs.

39175 **(DOE/PO/21431—T6) 1987 annual environmental monitoring report for the Strategic Petroleum Reserve.** (Boeing Petroleum Services, Inc., New Orleans, LA (USA)). Apr 1988. Contract AC96-85PO21431. 112p. NTIS, PC A06/MF A01;1; GPO Dep. Order Number DE88010378/JAW.

This report provided annually in accordance with DOE Order 5484.1 summarizes monitoring data collected to assess Strategic Petroleum Reserve (SPR) impact on the environment. The report serves as a management tool for mitigating such impacts, thus serving the public interest by ensuring environmentally sound operation of the SPR. Included in this report is a description of site environment, an overview of the SPR environmental program, and a recapitulation of special environmental activities and events associated with each SPR site during 1987. The active permits and the results of the environmental monitoring program (i.e., air, surface water, ground water, and water discharges) are discussed by site. The quality assurance program is presented which includes results from laboratory and field audits and studies performed internally and by regulatory agencies. In general, findings indicate that no adverse environmental impact resulted from any SPR activities during 1987. It was also concluded that the SPR continues to maintain an excellent environmental record. 20 refs., 8 figs., 15 tabs.

39176 (EC—1988, pp 18) **A mediation system for older leaking sites.** Whittaker, H. (Conservation and Protection Environmenta Canada, Ont.). [1988]. Infotech, Ste. 200, 1015 Centre St., N., Clagary Alta., Canada T2E 2P8; $35.00 CAN. (CE—01766; CONF-8706323—).

From Underground storage tank technology; Moncton, Canada (15 Jun 1987).

The technology developed to deal with the effluent from leaking undergound storage tanks has been largely aimed at recent,

fairly large releases where free product may be recovered largely unchanged. In the case of older small chronic release sites, this will not be the case. Natural processes will have altered the product to the extent that the efficiency of the technology is downgraded. A system has been developed to deal with this latter problem. It is based on membrane processes and activated carbon and is relatively simple to operate. Costs are expected to be competitive with the existing technologies. A prototype system was assembled and tested at a 50 year old petrochemical distribution terminal in Toronto. The results achieved were very good and indicate that a system of this type should work very well in the long term clean-up of sites for which it was intended. The system consists of a microfiltration or ultrafiltration unit, a reverse osmosis unit and granular activated carbon columns with associated tanks and plumbing. With this system, it is possible to take feed, varying greatly in quality, from the well point or drain, reduce the volume of solids and oil and grease to a very small fraction of the original fluid volume and process the associated water with very high removal efficiencies. Percent removal of components varied from 80-100%. Components included suspended solids, oil and grease, total organic carbon, benzene, toluene, xylenes, ethylbenzene and hexane.

39177 **(EGG—10617-2004) Endangered Species Program: Naval Petroleum Reserves in California: Annual report FY87.** (EG and G Energy Measurements, Inc., Goleta, CA (USA). Santa Barbara Operations). Feb 1988. Contract AC08-88NV10617. 42p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number TI88012462/JAW.

Construction and development activities conducted by the US Department of Energy (DOE), Naval Petroleum Reserves in California (NPR-C), at Naval Petroleum Reserve No. 1 (NPR-1) in compliance with the Naval Petroleum Reserves Production Act of 1976 (Public Law 94-258) potentially threatened the continued existence of three federally-listed endangered species: the San Joaquin kit fox, (Vulpes macrotis mutica), blunt-nosed leopard lizard (Gambelia silus), and giant kangaroo rat (Dipodomys ingens). All three are protected under the Endangered Species Act of 1973 (as amended) (Public Law 93-205) which declares that it is the policy of Congress that all Federal departments and agencies shall seek to conserve endangered and threatened species and shall utilize their authorities in furtherance of the purposes of the Act. DOE is also obliged to determine whether actions taken by their lessees on Naval Petroleum Reserve No. 2 (NPR-2) will have any detrimental effects on endangered species or their habitats. 54 refs., 2 figs., 19 tabs.

39178 **(EPS—IP2) Pollution abatement review with respect to heavy crude oil upgrading, synthetic crude use at refineries, increased natural gas processing, and liquified natural gas facilities.** (Environment Canada, Ottawa, Ontario. Environmental Protection Service). Aug 1982. vp. (CE—01420). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

RTM Engineering Ltd. has carried out a review of Canadian environmental control aspects of heavy crude upgrading, synthetic crude use at refineries, increased natural gas processing, and liquefied natural gas facilities. This review includes consideration of anticipated changes in product demands, process facilities, refinery and gas plant feedstocks. The study has concentrated on the potential environmental impacts of changes in, and additions to, the present hydrocarbon processing industries, and of the regulatory setting for such industries. The Canadian hydrocarbon processing industry is defined as being those facilities which receive hydrocarbon feedstocks from some resource extraction system and its connecting pipelines, and deliver marketable products to another such facility or petrochemical plant, and/or to end users. This report is intended to provide a general background on the environmental aspects of the present Canadian hydrocarbon processing industy, project that view through 1990, and indicate potential future concern areas in environmental control and in the regulatory setting. Throughout the report, current pollution abatement projects, potential waste and emissions implications, assay data and treatment technologies are assessed for each major area of the industry. 21 refs., 63 figs., 54 tabs.

39179 **(LTWS—13) Analysis of, and countermeasures against, accidents involving petroleum under the aspect of groundwater protection. Pt. 4. Description of accidents involving petroleum.** (Bundesministerium fuer Umwelt-, Naturschutz und Reaktorsicherheit, Bonn (Germany, F.R.). Beirat Lagerung und Transport Wassergefaehrdender Stoffe (LTWS); Umweltbundesamt, Berlin (Germany, F.R.)). Feb 1981. 123p. (In German). Umweltbundesamt, Berlin, Germany, F.R.

This volume presents a general description of the behaviour of petroleum in soil. The more specific accident conditions are treated as briefly as possible. The examples were chosen with a view to practical aspects. Porous and fissured soil types are treated separately. After some examples of accidents in loose rock, accidents in solid rock are treated. (orig./PW)

39180 **(LTWS—18) Analysis of, and countermeasures against, accidents involving petroleum under the aspect of groundwater protection. Pt. 2. Investigation of accidents involving petroleum and practical implementation of countermeasures and remedy measures.** (Bundesministerium fuer Umwelt-, Naturschutz und Reaktorsicherheit, Bonn (Germany, F.R.). Beirat Lagerung und Transport Wassergefaehrdender Stoffe (LTWS); Umweltbundesamt, Berlin (Germany, F.R.)). May 1984. 66p. (In German). Umweltbundesamt, Berlin, Germany, F.R.

Part 2 discusses preventive and remedy measures, the main purpose of this manual. The catalogue of measures is far from complete, but care has been taken to describe the principles on which they are based in order to deepen the reader's fundamental knowledge. (orig./PW)

39181 **(PB—88-146030/XAB) Survey of rocky shores in the region of Sullom Voe, Shetland, August 1986.** Hiscock, K. (Field Studies Council, Pembroke (UK). Oil Pollution Research Unit). 1986. 26p. (FSC/OPRU—31/86). NTIS, PC E05/MF E05.

Following an assessment of the results of annual rocky shore surveys in the region of Sullom Voe from 1976 to 1981, it was recommended that experienced biologists undertake a field check of all rocky-shore transects there in August of each year. The report describes the work undertaken during four days in late August 1986.

39182 **(PB—88-146048/XAB) Chemical and biological monitoring in Sullom Voe, 1986.** Westwood, S.S.C.; Dodd, N.M.; Smith, J. (Field Studies Council, Pembroke (UK). Oil Pollution Research Unit). 1987. 177p. (FSC/OPRU—33/86). NTIS, PC E09/MF E09.

See also PB—84-115617.

This report describes the results of the ninth chemical and macrobenthic monitoring survey carried out in Sullom Voe. In 1986, 26 stations in Sullom Voe, Calback Ness, Garths Voe and Orka Voe were sampled to provide a quantitative description of the benthic macrofauna. Sediment samples were also taken for hydrocarbon, organic carbon, and nitrogen, percentage combustibles and grain-size analyses. Water column and sediment chemical measurements were carried out at all stations. Samples of sediment along transects from high to low water at 3 soft shores were taken for hydrocarbon and grain-size analyses. Several additional samples were obtained to aid in interpretation of hydrocarbon data. Photographs of lines of sight were taken at the 2 new stations, and retaken at stations where they were previously unclear.

39183 **(PB—88-201165/XAB) Underwater sightings of sea turtles in the northern Gulf of Mexico. Final report.** Rosman, I.; Boland, G.S.; Martin, L.; Chandler, C. (LGL Ecological Research Associates, Inc., Bryan, TX (USA)). Oct 1987. 46p. NTIS, PC A03/MF A01.

See also PB—84-144138.

Between 1975 and 1985, eight scientific studies were conducted in the northern Gulf of Mexico. The purpose here was to review the data collected from all eight studies for information concerning underwater sightings of sea turtles. Records of 1,024 scuba dives, 909 hours of underwater video and submersible observations, and some 1,500 days of time-lapse photographic observations were

compiled from published reports, data logs, and photographic material. The effort yielded 268 verifiable underwater sightings of sea turtles, 231 of which came from time-lapse cameras. The majority of sightings that could be identified by species were of loggerheads. Other species sighted included three leatherbacks and one Kemp's Ridley.

39184 (PB—88-202973/XAB) Comparison of flow-through and towed fluorometers for measuring oil concentrations in the sea. Hurford, N.; Buchanan, I.; Law, R.J.; Hudson, P.M. (Warren Spring Lab., Stevenage (UK)). Jun 1987. 16p. (LR—621(OP)M). NTIS, PC E04/MF E04.

This report describes a comparison between two techniques for the continuous measurement of sub-surface concentrations of oil; one using a flow-through fluorometer and the other a towed, submersible fluorometer. The performance of the two instruments was compared during a field trial carried out by Warren Spring Laboratory and the Fisheries Laboratory. Both instruments were found to give very similar outputs beneath both non-dispersed and chemically dispersed oil slicks. The trial showed that the choice of instrument will be dependent on the intended application. The flow-through fluorometer is the preferred instrument for measuring concentrations beneath experimental oil spills whereas the towed fluorometer is more suitable for water-quality studies.

39185 (RER—EE95) Oils spills in leads: tank tests and modelling. Buist, I.; Joyce, S.; Dickins, D.F. (Ross (S.L.) Environmental Research Ltd., Ottawa, Ontario (Canada); Dickins (D.F.) Associates Ltd., Vancouver, British Columbia (Canada)). Dec 1987. 104p. (MICROLOG—88-02058). Environmental Protection Directorate, Environment Canada, 351 St. Joseph Blvd., Terrasses de la Chaudiere, Ottawa, Ont., Canada K1A 0E7; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

The results of a literature survey and indoor and outdoor experiments have been combined to develop a preliminary computer model of oil spill fate and behaviour in pack ice leads. The model is based largely on theoretical considerations and small-scale experimental results thus requiring full-scale verification. The areas of major uncertainty are in heat transfer from a large, oiled lead and in the effects of waves and wave damping by slush ice in large-scale leads. The output of the model concentrates on the amount of oil available for countermeasures as a function of time. Both the experiments and the model indicate that very little oil is incorporated into growing ice in a lead; most remains on the surface of the new ice exposed to the atmosphere. Snowfall and lead closure resulting in ridging are considered to be the major processes that encapsulate oil and render it unavailable for countermeasures. Includes bibliography. 36 refs., 29 figs., 6 tabs.

39186 (RER—EE96) The transient submergence of oil spills: tank tests and modelling. (Ross (S.L.) Environmental Research Ltd., Ottawa, Ontario (Canada)). Dec 1987. 66p. (MICROLOG—88-02059). Environmental Protection Directorate, Environment Canada, 351 St. Joseph Blvd., Terrasses de la Chaudiere, Ottawa, Ont., Canada K1A 0E7; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

Based on theory and wind/wave tank test results, process equations incorporating oil properties and sea conditions have been developed to predict: whether or not a particular oil slick will break up into slicklets or blobs; the size of the resultant slicklets and blobs; the maximum transient submergence depth of the slicklets and blobs; and their distribution as a function of depth. These process equations have been incorporated into an oil spill fate and behaviour computer model that predicts oil spill spreading, evaporation, emulsifaction, natural dispersion, and transient submergence. The process equations were also simplified to allow quick estimates to be made for residual fuel oil spills and a range of emulsion mat sizes. 27 refs., 36 figs., 3 tabs.

39187 (TU—EE92) The behaviour of oil in freezing situations. Wilson, D.G.; Mackay, D. (Toronto Univ., Ontario (Canada)). Dec 1987. 65p. (MICROLOG—88-02078). Environmental Protection Directorate, Environment Canada, 351 St. Joseph Blvd., Terrasses de la Chaudiere, Ottawa, Ont., Canada K1A 0E7; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

An experimental study of the behaviour of an oil spill in a developing (grease) ice field is described. It was found that significant quantities of oil may be entrained within and beneath a grease ice field. The amount of oil entrained is increased by a high oil density occurring naturally or induced by weathering, the presence of sufficient turbulence to disperse the surface oil at an appreciable rate and induce mixing within the forming ice field, a high oil viscosity occuring naturally or induced by weathering, the formation of emulsions of sea water and/or ice in the oil, the formation of smaller oil droplets, and/or ice in the oil, the formation of smaller oil droplets, and the formation or coalescence of ice particles to a size of approximately 5 mm in diameter. It is suggested that the results and observations obtained here be used as a component in an expert system computer model that would aid in the prediction of the fate and behaviour of an oil spill in the presence of a developing ice field and in other regimes in which oil may interact with ice. This model may then be included as part of a comprehensive model encompassing the entire spectrum of oil spill conditions which may occur in the Arcitc marine environment. 26 refs., 12 figs., 3 tabs.

39188 (TU—EE93) Formation and stability of water-in-oil emulsions. MacKay, D. (Toronto Univ., Ontario (Canada)). Dec 1987. 44p. (MICROLOG—88-02079). Environmental Protection Directorate, Environment Canada, 351 St. Joseph Blvd., Terrasses de la Chaudiere, Ottawa, Ont., Canada K1A 0E7; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

The tendency for crude oil slicks to form water-in-oil emulsions on the sea surface results in substantial changes in behavior. As part of the effort to understand such behaviour, with a view to applying such understanding to oil spills countermeasures, this paper presents a review of recent literature, much of it from Russian sources, on the formation and stability of water-in-oil emulsions. It is generally thought that stability depends on asphaltene precipitation with possible dependence on the presence of waxes. The methods and analyses for those types of compounds used in previous studies were judged to be insufficiently accurate, and some experimental effort was devoted to developing and validating improved schemes. These schemes are described, along with experiments to elucidate the causes of emulsion stability. Experiments included the blending of natural crude oils to simulate oils of desired asphaltene content, and a series of experiments were made to see if the presence of a mechanical barrier to coalsecence could be determined by electrical resistivity measurements. The findings are discussed and a modified emulsion formation/stability hypothesis is presented which is consistent with Russian work, earlier work and current results. 66 refs., 9 figs., 3 tabs.

0210 Legislation And Regulation

REFER ALSO TO CITATION(S) 39169

39189 (ERCB/C—D88-4) Bonanza Oil & Gas Ltd. application for a well licence, Joffre Field. Decision D88-4. (Energy Resources Conservation Board, Calgary, Alberta (Canada)). 11 May 1988. 15p. (CE—01770). Energy Resources Conservation Board, 640-5th Ave. SW, Calgary, Alta., Canada T2P 3G4; $N/C.

Bonanza Oil & Gas Ltd. (Bonanza) applied for a licence to drill a well from a surface location near Red Deer, Alberta. The proposed well, to be known as BONANZA ET AL JOFFRE would be for the purpose of obtaining oil production from the Leduc Formation. Interventions to the application were received by the Energy Resources Conservation Board (the Board) from landowners and concerned persons in the vicinity of the proposed

well. Generally, the interventions did not take issue with the technical merits of drilling the well but rather the potential H/sub 2/S release rate in the event of a blowout, and the adequacy of the Emergency Response Plan (ERP) and associated Emergency Planning Zone. Two submissions were filed by individuals in support of the application. The Board considerd the issues with respect to the purpose and location of the well, the drilling of the well, the production of the well, the potential H/sub 2/S release rate, appropriateness of the ERP, submissions in support of the application, and the request for deferral. Views of the applicant, the interveners and the Board were represented. Having reviewed the evidence, the Board concluded that the drilling and production of the well can proceed in a safe manner.

0220 Transport, Pipelines, And Handling

39180 (IPL—1986) Interprovincial Pipe Line Limited annual report, 1986. (Interprovincial Pipe Line Ltd., Toronto, Ontario (Canada)). 1986. 40p. (CE—01444). Interprovincial Pipe Line Limited, PO Box 96, 150 King Street West, Toronto, Ont., Canada M5H 1J9; $N/C.

Interprovincial Pipe Line Limited, which commenced operations in 1950, is engaged in the business of transporting crude oil and other liquid hydrocarbons through a common carrier pipeline system. The system extends from Edmonton, Alberta across the Canadian Prairies through the Great Lakes region of the United States to Toronto, Ontario and Montreal, Quebec. In 1985 the Norman Wells crude oil pipeline, which extends from Norman Wells in the Northwest Territories to Zama in northwestern Alberta, began transporting oil. In December, 1986, IPL diversified into the upstream oil and gas sector with the acquisition of all of the shares of Home Oil Company Limited. Home is an exploration and production company with activities concentrated in Canada where it has been one of the most prominent players in western Canada and has an established position in the Canadian frontier. Home is also active internationally. This report reviews the operations of the pipeline system and the oil and gas company over the year, with appropriate statistics presented. Financial statements are also included.

0230 Properties

REFER ALSO TO CITATION(S) 39151, 39188, 39203, 39997, 40055

39191 (EMR—CRL8795) Concentration measurements in emulsions. Mansour, N.A. (Department of Energy, Mines and Resources, Ottawa, Ontario (Canada)). Sep 1987. 6p. (MICROLOG—88-02139). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1. $0.34 CAN per page, $3.40 minimum; MF $10 CAN.

Due to the unique microwave characteristics of water, microwave measurement techniques can be used to determine the water concentration in both heterogeneous industrial media and living matter. Unlike water molecules, the other components of heterogeneous media, e.g. oil and coal, usually have frequency and temperature independent dielectric characteristics. This paper presents results obtained using a microwave transmission technique for the measurement of the concentration of both phases in simple paraffin-in-water and water-in-paraffin types of emulsions. The results show that by using microwaves it is possible to determine the emulsion type, dispersed phase concentration, and inversion point in an emulsion. At a dispersed phase of 10%, for example, detector response for water-in-paraffin is about 88 times that for paraffin-in-water. For paraffin-in-water type emulsions, it was shown that the detector response was at least three times higher when the emulsion is inverted from paraffin-in-water to water-in-paraffin (at 50%). 6 refs., 2 figs.

39192 (PB—88-182548/XAB) Laboratory investigations of bitumen aging properties. Blomberg, T.; Haekkinen, M.R.; Schueller, S.; Berglund, L.; Isacsson, U. (Statens Vaeg- och Trafikinstitut, Linkoeping (Sweden)). 1988. 29p. (In Swedish). (VTI/MEDDELANDE—558). NTIS, PC E03/MF A01.

Comparative laboratory investigations of the aging properties of bitumen using two standardized methods, TFOT (Thin Film Oven Test, ASTM D 1754) and RTFOT (Rolling Thin Film Oven Test, ASTM D 2872), have been performed. Forty-seven samples of bitumen produced at three refineries from six different crude oils were examined before and after heating in accordance with TFOT and RTFOT respectively. The parameters investigated are penetration at 25 and 10°C respectively, dynamic viscosity at 60°C, kinematic viscosity at 135°C and change in mass in TFOT and RTFOT respectively. The penetration index, retained penetration and viscosity ratio have been calculated.

39193 Thermogravimetric fourier transform infrared spectroscopy (TG-FTIR) of petroleum source rocks. Initial results. Whelan, J.K.; Solomon, P.R.; Deshpande, G.V.; Carangelo, R.M. (Woods Hole Oceanographic Institution, MA (USA)). *Energy and Fuels;* 2: No. 1, 65-73(Jan-Feb 1988). Contract FG02-86ER13466.

The first results of thermogravimetric Fourier transform infrared analysis (TF-FTIR), as applied to petroleum source rocks, are reported. Sample preparation and running time, roughly equivalent to those used for Rock Eval source rock pyrolysis analyses, are described. Initial results show that the TG-FTIR technique provides considerable additional geochemical information including the following: (a) Simultaneous T/sub max/ values for thermal evolution of a number of constituents in addition to hydrocarbons and carbon dioxide-including methane, ethylene, carbon monoxide, ammonia, hydrogen cyanide, sulfur dioxide, and COS are obtained. T/sub max/ values of several of these-including methane, ethylene, and ammonia-show progressive increases with maturation state. For one Alaskan North Slope well (Seabee), these T/sub max/ values show an excellent correlation with vitrinite reflectance. (b) Data required for calculation of material balances of organic and inorganic sedimentary carbon, nitrogen, and sulfur are obtained. (c) Data for classification of sedimentary organic matter into kerogen types I, II, and III (using either plots of organic H/C versus O/C or H/C versus organic carbon ratios) as well as data for classification according to depositional environment (using thermal evolution patterns of ammonia, HCN, SO_2, and COS and possibly CO_2) are obtained.

0240 Storage

REFER ALSO TO CITATION(S) 39175, 39176

39194 (EC—1988) Underground storage tank technology. (Environment Canada, Ottawa, Ontario; Petroleum Association of Conservation of the Canadian Environment, Ottawa, Ontario; International Association of Hydrogeologists (Canada)). [1988]. 122p. (CE—01766; CONF-8706323—). Infotech, Ste. 200, 1015 Centre St., N., Calgary, Alta., Canada T2E 2P8; $35.00 CAN.

From Underground storage tank technology; Moncton, Canada (15 Jun 1987).

The conference program dealt with aspects of tank leakage: prevention, liability, detection, and clean up. Tank design was also discussed. Eight articles from the program were abstracted.

39195 (EC—1988, pp 11) Some European perspectives on prevention of leaks from undergound pretroleum storage systems. Moreau, M. (Board of Underground Oil Storage Tank Installers, ME). [1988]. Infotech, Ste. 200, 1015 Centre St., N., Calgary, Alta., Canada T2E 2P8; $35.00 Can. (CE—01766; CONF-8706323—).

From Underground storage tank technology; Moncton, Canada (15 Jun 1987).

In this paper the author compares European methods of underground tank management. Aspects covered include tank standards, piping, pumps and overfill protection. Also discussed are means of testing, construction and installation.

39196 (EC—1988, pp 20) The US Environmental Protection Agency Leak Test Program. Farlow, J.S.; Maresca, J.W.Jr.; Starr, J.W. (US Environmental Protection Agency; VISTA Research, Inc.). [1988]. Infotech, Ste. 200, 1015 Centre St., N., Calgary, Alta., Canada T2E 2P8; $35.00 Can. (CE—01766; CONF-8706323—).

From Underground storage tank technology; Moncton, Canada (15 Jun 1987).

This paper describes the approach being used by the United States Environmental Protection Agency's Hazardous Waste Engineering Research Laboratory to evaluate volumetric methods for detecting leaks in underground storage tanks. Of the 43 methods originally identified, 30 are still participating in the program. Many of the methods are still being refined. Using a laser interferometer as a measurement standard, EPA is obtaining careful measurements in a specially-constructed full-scale tank system at their Edison, NJ, facility to define those ambient noises any detection method must overcome. This large body of data is used with a mathematical model of each method; the resulting predicitons are compared with those from verification test data obtained by the vendor at EPA's test system. 8 refs., 1 fig.

39197 (EC—1988, pp 10) **Pollution liability and compensation.** Matilla, K. (Conservation of the Canadian Environment, Ontario). [1988]. Infotech, Ste. 200, 1015 Centre Ste., N., Calgary, Alta., Canada T2E 2P8; $35.00 Can. (CE—01766; CONF-8706323—).

From Underground storage tank technology; Moncton, Canada (15 Jun 1987).

Underground tank leaks are recognized as an environmental threat. They also can pose a major financial burden on the owner or operator. It is estimated that from 3 to 6% of tanks in Canada could be potential leakers today. US experience suggests that an average leak clean up can cost anywhere from $20,000 to well over $1 million. The potential liabilities are enormous. Governments in Canada are looking at US programs which now will bring underground tank leaks under the Superfund legislation. A provision of US law is that tank owners must demonstrate financial responsibility of $1 million. In Canada, Quebec now requires $500,000 protection. The Federal government and provinces, through the Canadian Council of Resource and Environment Ministers, is in the early stages of discussion on an environmental compensation fund for Canada. The implication for tank owners of these trends is reviewed. While it is still too early to predict the outcome of these developments, it is becoming very clear that industry and governments will have to work together to achieve good solutions.

39198 (EC—1988, pp 9) **Techniques for predicting the consequences of tank leakage.** Lee, P.K. (Gartner Lee Ltd., Ont., Canada). [1988]. Infotech, Ste. 200, 1015 Centre St., N., Calgary, Alta., Canada T2E 2P8; $35.00 CAN. (CE—01766; CONF-8706323—).

From Underground storage tank technology; Moncton, Canada (15 Jun 1987).

One technique that can be used to predict the relative consequences of tank leakage is the analysis of an information base in the context of source-pathways-receptors. Each of those three components must be analyzed and docomented on its own and then on an interrelated basis. Much of the information base can be developed from existing information in the form of reports, plans and records. The source information should be available from company files and will be related to data on the tanks and piping itself through the nature and volume of the product being stored. The pathway may be much more complex to assess than the source. The pathway will require a knowledge of the natural physical setting, ground water flow and contaminant migration mechanisms. Although existing data may provide sufficient information, additional work on site may be required. Professional assistance may be needed. Both natural and man made system must be considered. The receptor may be such that there is a risk to human life and health by explosion through to impact on water well supplies and surface waters. The assessment of consequences by this technique provides a basis for storage tank management and for setting of priorities for replacement, upgrading and decommissioning. The data base can also be used to plan and implement detail on site investigations of leaks and clean-ups.

39199 (EC—1988, pp 13) **Soil characteristics as a means of determining useful life of underground tanks.** Kennedy, N.A. (Warren Rogers Assoc., Inc., RI, USA). [1988]. Infotech, Ste. 200, 1015 Centre St., N., Calgary, Alta, Canada T2E 2P8; $35.00 CAN. (CE—01766; CONF-8706323—).

From Underground storage tank technology; Moncton, Canada (15 Jun 1987).

Soil survey analysis gives predictions of when tank leakage will occur. It is the basis for realistic management of undergound tank systems, meaningful multi-year planning and budgeting, and the prevention of leaking tanks. This paper recaps information about the exploratory statistical work which led to the development of an accurate empirical model for prediction of leaking tank situations; two different types of corrosion and their significance in leaking tank systems; empirical model principles and its distinctive leak predictive characteristics; interpretation of corrosion survey probabilities; and the rationale of a Canadian company for utilizing soil corrosion survey as a means for effectively managing their underground tank systems. This paper provides information for better understanding of the corrosion soil survey, which, if utilized effectively, can greatly enhance the whole process of underground tank management. 4 figs.

39200 (EC—1988, pp vp) **Nylon 6 underground storage tanks.** Appleyard, R.D. (Nylon 6 Canada Ltd., Ont.). [1988]. Infotech, Ste. 200, 1015 Centre St., N., Calgary Alta., Canada T2E 2P8; $35.00 CAN. (CE—01766; CONF-8706323—).

From Underground storage tank technology; Moncton, Canada (15 Jun 1987).

A seamless nylon underground storage tank is described as a corrosion free alternative to the existing steel fibre reinforced plastic tank. The novel design featuring a flat bottom, arched top, deeply ribbed vertical sides, zero spacing between adjacent tanks, and sand backfill, offers significant reductions in installation cost with a less significant increase in unit tank cost to yield a net reduction in installed cost. The enhanced cross-sectional area results in substantial shortening of the tank and hence reduced ground space requirements, offering a greater flexibility to the installation designer with respect to site placement of tankage. The compatibility of nylon with fuels has long been acknowledged as have its durability, resistance to impact and abrasion, and structural strength. The economic use of the material in large thin walled hollow structures has only now become possible by the development of a reaction molding process and machinery by the company. The initial tanks will be produced in October 1987 and will undergo testing to the current FRP National Standard. On successful completion, approval will be given for preliminary installations at revenue sites by the oil companies under waivers of deviations to the Ontario Gas Handling Act.

39201 (EC—1988, pp 23) **Double walled, vacuum monitored, liquid storage tanks: the environmentally safe total containment system.** Fernandes, E.G. (Clemmer Industries Ltd. (1964), Ont., Canada). [1988]. Infotech, Ste. 200, 1015 Centre St., N., Clagary Alta., Canada T2E 2P8; $35.00 CAN. (CE—01766; CONF-8706323—).

From Underground storage tank technology; Moncton, Canada (15 Jun 1987).

Double walled, vacuum monitored, storage tanks provide a proven method for the safe storage of environmentally sensitive liquids through continuous vacuum monitoring of the interstice between the walls. The addition of electronically monitored dual wall piping and in house audio/visual alarm systems results in a total containment system that offers exceptional litigation protection from possible damage claims due to undetected product leakage. Developmental work on design combining the corrosion plastic inner tank, with the strength of steel, an outer tank manufactured from hot rolled steel and provided with the proper external corrosion protection systems, and continuous vacuum monitoring indicates that environmentally safe storage systems for some of the more hazardous and corrosive liquids is a definite possibility.

0250 Combustion

39202 **(STU—83-3517) Motor fuel combustion. Chemical reactions.** Rosengren, L.G. (Swedish National Board for Technical Development, Stockholm). 15 Oct 1986. 27p. (In Swedish). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88753752/JAW.

Combustion of the fuel components n-octane and i-octane was studied in a flat flame at 9.3 kPa pressure. The contents of different substances were registered by molecular mass spectroscopy. Many intermediaries were identified. It was observed that the fuel molecules are successively degraded to C/sub 1/- and C/sub 2/-fragments before being oxidized CO. From these results detailed oxidation reaction mechanisms of n-octane and i-octane were put together and tested i.a. in the flame experiments. The mechanisms are based on a butane mechanism added to reactions of C/sub 5/-C/sub 8/-species and contains about 60 substances and 350 reactions each. By burning methanol fuels in an engine water is always present. The influence of water was investigated in a flat flame and by simulation in regard to a methanol oxidation mechanism. The results show no noticeable influence of 10 % water addition. However, calculations indicate i.a. higher flame velocities by increasing water content. Sensitivity analysis of the method mechanism indicates significance of the reactions H+O/sub 2/, CO+OH and HCO+M'. (O.S.).

39203 (TC/TDC—TP4428E, pp 37-66) **Possibilities for diesel locomotive fuels.** Jackson, D.R. (CN Rail Research Centre, Canada). 15 Mar 1983. Transport Canada, Montreal, Quebec. Transportation Development Centre. (CE—01644; CONF-8303232—).

From Transportation development centre railway energy seminar; Montreal, Canada (15 Mar 1983).

This paper describes investigations into use of alternate diesel fuels in railway locomotive engines. These fuels have met specifications related to flash point, sulfur content, cloud point, and cetane number, all of which will be different with substitute fuels, possibly affecting engine performance. Gas oil side stream fuel from the Athabasca deposit has been used as about 18% of the fuel used by CN Rail, and maintenance and availability records for engines using this fuel have been indistinguishable from records for engines using standard fuel. Use of No.2 furnace oil has also been tried by CN Rail with no known effect on engine performance, with the exception of low cloud point in some fuels causing wax problems at low temeratures. Blended fuels, made from a mixture of distillates typically described as Bunker C, present possible problems due to poor combustion characteristics at idle and low power, and the presence of undesireable contaminants from the refining process, such as vanadium and aluminium. However, due to the low cost of blends, their use is attractive, even with possible increase engine maintenance costs. Testing by CN Rail has been carried out; stationary tests show 30% Bunker C blends can be burned at higher power levels with good combustion efficiency and with economic advantages; 10% bunker C seems to be the limit. Field trails showed that 10% bunker C blends can be used in southern Ontario year round. Effects on engine wear and durability are not yet fully clear, but indications show some increase in wear which may not be a disadvantage given the lower fuel price. If blended fuels could be used where conceivably available in Eastern Canada, cost savings could be $6 to 19 million depending on the bunker C concentration. 17 refs., 3 figs., 9 tabs.

39204 (TC/TDC—TP4428E, pp 67-82) **Alternative fuels testing by Bombardier.** Dunton, R.M. (Bombardier Inc., Canada). 15 Mar 1983. Transport Canada, Montreal, Quebec. Transportation Development Centre. (CE—01644; CONF-8303232—).

From Transportation development centre railway energy seminar; Montreal, Canada (15 Mar 1983).

This paper describes a testing program carried out on a 12 cylinder 251 F diesel engine, in order to give a critical evaluation of alternative diesel fuels. The objective was to determine further areas for testing, leading to improvement of performance. The reference fuel was standard commercial ASTM No.2D fuel, and the engine was operated with this fuel before and after each test with alternate fuel. The alternate fuels tested were an otherwise-conventional diesel fuel with a high end point, a fuel with a high percentage of hydrocracked components, high aromatic content, and low cetane, blended to simulate diesel fuel available in 1990, a Fort McMurray Tar Sand blend, a modified heating oil called No.3RR, and a blend of 25% No.6 with 75% No.2 heating oil. This paper presents the preliminary results of fuel performance, by measurements of fuel injection pressure, combustion delay, maximum rate of pressure rise (the early indication of knock or detonation), maximum cylinder pressure, smoke production, and fuel consumption. Results from fuel consumption tests are rather discouraging, as they tend to show that some of the marginal cost savings from using the alternate fuels tested may be offset by poorer performance. 6 figs.

03 NATURAL GAS

REFER ALSO TO CITATION(S) 39075, 39076, 39077, 39078, 39079

39205 **(PB—88-213830/XAB) Gas Research Institute results of appraisal of GRI 1989-1993 R and D.** (Gas Research Inst., Chicago, IL (USA)). Jun 1988. 173p. NTIS, PC A08/MF A01.

See also PB—88-123120.

This report provides (1) a description of the GRI planning process and the functional roles of GRI staff and management in implementing that process, (2) an overview of the Project Appraisal Methodology (PAM), and (3) the output of the planning process for the development of the 1989 R&D Program and the 1989-1993 R&D Plan. The appendices provide further insight into PAM methodology and the major assumptions inherent in its use; include the PAM Reference Data Base on fuel costs and market size and demand; summarize key PAM input data and output results for the 1989-1993 R&D Plan, including the expected impact of GRI's R&D Program in terms of energy savings, consumer savings, and consumer options enhanced/new gas load; show representative PAM input data forms used for characterizing supply, end use, and gas operations technologies; and provides detailed sample calculations on a technology-level basis for the three overall objectives of Supply Options, End Use, and Gas Operations.

0302 Geology And Exploration

REFER ALSO TO CITATION(S) 39114, 39129, 39133, 41626, 41630

0303 Drilling, Production, And Processing

REFER ALSO TO CITATION(S) 39136, 39138, 39140, 39141, 39142

39206 **(PB—88-203211/XAB) Reservoir engineering and treatment design technology. Annual report, December 1986-November 1987.** Murtha, J.A.; Gatens, J.M.; Lancaster, D.E.; Lane, H.S.; Lee, W.J. (Holditch (S.A.) and Associates, Inc., College Station, TX (USA)). Dec 1987. 223p. NTIS, PC A10/MF A01.

The key achievements in the first year of this project were participation in the early stages of the GRI-sponsored Comprehensive Study Well (CSW) program; preliminary efforts to analyze stress tests; development of a single-layer, radial, composite reservoir model; and development of a constrained, automatic history-matching algorithm. Much of the first year was spent working with other GRI contractors organizing the CSW program and designing appropriate experiments for the CSW's. The stress tests are being conducted to determine the in-situ stress profile in the Devonian Shales. Preliminary analysis of stress test data from CSW No. 2 indicates that the Upper Devonian Undivided interval has a higher in-situ stress gradient than the lower intervals of the Devonian Shales.

0304 Products And By-products

REFER ALSO TO CITATION(S) 40241, 41229

0305 Health And Safety

REFER ALSO TO CITATION(S) 39154, 39155

39207 **(PB—88-210620/XAB) Environment and safety research status report: 1987-1988.** (Gas Research Inst., Chicago, IL (USA)). Mar 1988. 184p. (GRI—88/0126). NTIS, PC A09/MF A01.

See also PB—88-160106.

The status of ongoing and planned activities in GRI's Environment and Safety Research Program are discussed. These activities are divided into three subprograms: Supply (natural gas and substitute natural gas); End Use (indoor air quality and safety, and combustion systems emissions control); and Gas Operations (transport and storage). The objectives and goals, accomplishments, and strategy are presented along with the basis for each project area. Approved obligation budgets for 1987 and 1988 and the preliminary 1989 budget for each project area are included.

0306 Marketing And Economics

REFER ALSO TO CITATION(S) 39157, 39158, 39163, 39164, 39165, 39166, 39167, 39190, 39211, 40040, 40041

39200 (APUB—E8712887C) Gas supply and transportation service inquiry. (Alberta Public Utilities Board, Edmonton (Canada); Energy Resources Conservation Board, Calgary, Alberta (Canada)). 29 Dec 1987. 36p. (MICROLOG—88-01868). Energy Resources Conservation Board, 640-5th Ave. SW, Calgary, Alta., Canada T2P 3G4; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

The gas producing and marketing industries in Canada have been moving toward greater market orientation, and the Alberta Public Utilities Board (PUB) and Energy Resources Conservation Board (ERCB) have held inquiries into matters related to this, namely: the basis for determining the classes of consumers of natural gas who should be protected by contracts for the supply of natural gas that ensure long-term security of supply; the terms and conditions of contracts that would ensure long-term security of supply for those consumers; the availability of transportation service for natural gas to consumers who wish to contract directly with producers and others for natural gas supplies; any changes that may be required to the terms of access to transmission and distribution facilities, to make them consistent with the government's policy concerning long-term security of supply; and any other matters considered by the PUB and ERCB to be relevant. The Boards have concluded that the major element of the public interest under consideration is security of supply for appropriate consumers. They have proceeded on the understanding that the Alberta government intends to implement a policy whereby the security of natural gas supply for those classes of consumers in the core market will be provided by mandated contracts. The core market should include residential and commercial consumers. Non-core customers would be allowed to arrange supply and transportation contracts for whatever term they felt appropriate, at rates designed to cover all associated costs.

39209 (DOE/EIA—0130(88/02)) Natural gas monthly, February 1988. (USDOE Energy Information Administration, Washington, DC. Office of Oil and Gas). 2 May 1988. 131p. NTIS, PC A07 - GPO;3. Order Number DE88009908/JAW.

Current data on natural and supplemental gas consumption, disposition, production, prices, storage, imports, and exports in the United States are provided for each year from 198 throught February 1988 with monthly data for the most recent three years. Some data are also given by State or city; some data are also given for previous years. Operating and financial data for major interstate natural gas pipeline companies, as well as data on filings, ceiling prices, and transportation under the Natural Gas Policy Act of 1978, are also included. 6 figs., 33 tabs.

39210 (PB—88-210638/XAB) GRI's (Gas Research Institute's) Gas Appliance Technology Center: 1986 annual report (activity at Battelle). Annual report, January 1, 1986-December 31, 1986. Locklin, D.W. (Battelle Columbus Div., OH (USA)). Oct 1987. 46p. NTIS, PC A03/MF A01.

See also PB—88-191002.

The goal of GRI's Gas Appliance Technology Center is to foster the introduction of a new generation of highly efficient, cost-effective gas appliances for residential and commercial gas users. The report covers activity at Battelle during 1986 on eight tasks: (1) the quarterly G/A/S Newsletter, (2) an InfoBase of published reports on related research, (3) burner analysis including noise, NOx emissions, and modeling, (4) Burner Technology Bulletins, (5) venting of conventional, power, and condensing-type burners, (6) new residential uses for natural gas, (7) multizone heating field tests, and (8) NO_x removal by residential construction materials. These and additional tasks are described briefly with references to published reports that provide more-detailed descriptions of the results of the work conducted.

0308 Environmental Aspects

REFER ALSO TO CITATION(S) 39110, 39138, 39178, 39183, 39207, 40079, 40239, 41168, 41303, 41304, 41305, 41306, 41340, 41341, 41343, 41344, 41345, 41346

0310 Legislation And Regulation

REFER ALSO TO CITATION(S) 41168

39211 (BCUC—25111987) Decision in the matter of the Utilities Commission Act S.B.C. 1980, c.60, as amended and in the matter of application by Inland Natural Gas Co. Ltd., and Superior Propane Inc., November 25, 1987. (British Columbia Utilities Commission (Canada)). 25 Nov 1987. 35p. (CE—01601). British Columbia Utilities Commission, 800 Smithe St., 4th Floor, Victoria, B.C., Canada V6Z 2E1; $N/C.

Inland Natural Gas is the second largest natural gas distribution utility in British Columbia. Inland made appliction approving its acquisition from Superior Propane of 100% of the shares of Squamish Gas, a public utility. Inland proposed that it would cause Squamish Gas to purchase from Superior all of the assets of Granisle Grid System and to hold and operate such assests as a separate regulatory unit within Squamish Gas. Inland further submitted that its proposed acquisitions would have no detrimental effect upon: the utilities' ability to finance future capital requirements, the continuation of existing convenants that would preserve the customers' interests, the utilities' ability to maintain the required level of service into the future, the preservation of the public interest, and compliance with pertinent legislation and regulations. A public hearing was held before the British Columbia Utilities Commission to consider these matters. The Commission concluded that there is no reasonable basis for anticipating detrimental effects on either the utility or its customers attributable to the acquisition of Squamish Gas by Inland. On the contrary, the Commission is of the view that beyond the immediate benefit which will emerge in the anticipated rate reduction, there will be other as yet unquantified benefits attributable to ownership and operation by a company whose expertise and experience is caused on utility operations. With respect to the proposed sale of the assests of the Granisle Grid System by Superior Propane to Squamish Gas, the Commission concluded that the uncertainties facing the future of Granisle are the result of external market forces regardless of who owns the assests, and that in the circumstances ownership of those assets by an experienced utility operator is in the public interest.

0320 Transport, Pipelines, And Handling

REFER ALSO TO CITATION(S) 39208

39212 (NPA—1988) [Northern Pipeline Agency] annual report, 1986-1987. (Northern Pipeline Agency, Ottawa, Ontario (Canada)). 1988. 37p. (In English and French). (MICROLOG—88-01772). Northern Pipeline Agency (Canada), 200 Kent St., Stn. 210, Ottawa, Ont., Canada K1A 0E6; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

The Northern Pipeline Agency was established to facilitate the efficient and expeditious planning and construction of the Alaska Highway Gas Pipeline in a manner consistent with the best interests of Canada. This report reviews the annual progress of this process. It gives an overview of the project and outlines develop-

ments that will affect operations of the pre-build and planning for second-stage construction of the pipeline. Financial statements for the Agency are also included.

39213 (PB—88-205869/XAB) Transport and Storage Research (3.3) Program for Gas Operations Research and Development: status report-1986 projects. (Gas Research Inst., Chicago, IL (USA)). Mar 1987. 194p. (GRI—87/0367). NTIS, PC A09/MF A01.

See also PB—88-205877.

The 1986 status report presents information on current and proposed activities in the GRI Transport and Storage Research Subprogram, a part of GRI's Gas Operations Research and Development Program. A common theme across project areas in the subprogram is the maintenance and enhancement of the nation's gas distribution, storage, and transmission network that links gas-supply sources to the end-user. These project areas are construction and maintenance, metering and distribution operations, plastic piping materials evaluation, residential/commercial interior piping systems, gas storage technology, metal transmission and distribution piping systems, and advanced transport systems. The status report presents descriptions of the major issues, objectives, initiatives, and strategies of the subprogram. Also included are contract summary reports for each research project in the seven project areas.

39214 (STF—75A87017) Gas terminal field study: Handling of process disturbances from a visual unit based control centre. Bodsberg, L.; Ingstad, O.; Sten, T. (Selskapet for Industriell og Teknisk Forskning, Trondheim (Norway)). Jul 1987. 77p. (In Norwegian). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88753745/JAW.

This report is a documentation of a field study performed at the Kaarstoe gas terminal in Norway. The purpose of the study was to systematize and learn by the experinces, gained in handling process disturbances in a control centre based on visual display units. The study is part of the KRIOP project (Crisis Intervention in Offshore Production). The report is based on interviews with operators, observations, questionaires and examiniation of documents. 7 refs., 7 figs.

39215 (UG—1987) Union Gas annual report, 1987. (Union Gas Ltd., Toronto, Ontario (Canada)). 1987. 57p. (CE—01445). Union Gas Limited, 50 Keil Drive North, Chatham, Ont., Canada N7M 5M1; $N/C.

Union Gas Limited is Canada's second largest natural gas distribution utility serving over 534,000 residential, commercial and industrial customers in southern Ontario. It owns and operates a fully integrated system of storage, transmission and distribution facilites to serve the communities situated in an area stretching from Windsor in the west to Oakville in the east and from Owen Sound in the north to the Lake Erie shore in the south. In addition, Union's storage, transmission facilites form an integral part of the delivery system bringing western gas to eastern Canada. Union Gas has its head office in Chatham, Ontario, and its four regional offices in the cities of Windsor, London, Waterloo, and Hamilton. Union Gas Limited is a wholly owned subsidiary of Union Enterprises Ltd., one of the UniCorp Canada Corporation group of companies. With the publication of this annual report, Union Gas presents a view of its activities in gas supply and marketing, operations, engineering, and regulatory affairs. Financial statements are also included.

0330 Properties

REFER ALSO TO CITATION(S) 39218

39216 (PB—88-192828/XAB) Chemical and catalytic activation of methane by metal-oxide surfaces. Annual report, September 1, 1986-August 31, 1987. Quinlan, M.A.; Sancier, K.M.; McCarty, J.G. (SRI International, Menlo Park, CA (USA)). Jan 1988. 63p. NTIS, PC A04/MF A01.

The effect of reactant and product partial pressure on methane activation kinetics was examined for a series of alkali-promoted alkaline earth oxide catalysts. In the limit of vanishing oxygen partial pressure the C^{2+} product selectivity exceeded 70% (C basis) and the ethene/ethane ratio approached zero. The kinetics are consistent with the competitive gas phase dimerization and the oxidation (both homogeneous and heterogeneous) of heterogeneouly produced methyl radicals. Post-reaction temperature-programmed desorption experiments following stationary-state oxidative dimerization of methane by Na-promoted CaO and Li-promoted MgO help describe a physical picture of the working catalysts. Multilayer quantities of CO_2 and fractional monolayer quantities of O_2 and H_2O were evolved by the TPD experiments suggesting that a layer of molten alkali carbonate with surface hydroxide and surface oxide is formed during the partial oxidation reaction. Surface O- species have been previously implicated as the reactive centers for methane activation by electron spin resonance (ESR) observations with quenched catalysts. However, thermally produced alkali-oxygen radical anion centers were not observed in ESR experiments to temperatures as high as 850 K with lithium-promoted MgO and sodium-promoted CaO catalysts.

0340 Combustion

REFER ALSO TO CITATION(S) 39210, 39600, 41244

39217 (PB—88-191028/XAB) Reports published by the Gas Research Institute in the area of residential/commercial appliances and space-conditioning: bibliography and abstracts for the period 1978-1987. Murphy, M.J.; Locklin, D.W.; Johnson, O.D. (Battelle Columbus Div., OH (USA)). Feb 1988. 62p. NTIS, PC A04/MF A01.

See also report dated May 87, PB—87-235628.

This bibliography contains citations of reports published by the Gas Research Institute pertaining to residential and commercial gas appliances and space-conditioning equipment. It does not include heat pumps or cogeneration. The reports are listed in date order and are indexed by subject, author, and GRI report number. Report citations include abstracts taken from the NTIS data base. The bibliography was compiled and indexed from the Gas Appliance Technology Center (GATC) InfoBase, an electronic data base of evaluated references in the area of gas-appliance technology.

39218 (PB—88-212568/XAB) Laser probes of natural gas ignition chemistry. Annual report, January 1987-December 1987. Crosley, D.R.; Smith, G.P.; Golden, D.M. (SRI International, Menlo Park, CA (USA)). Jan 1988. 139p. (SRI-MP—88-044). NTIS, PC A07/MF A01.

See also PB—87-209599.

The research described is aimed at developing and using laser-induced fluorescence of various hydrocarbon species as probes in natural gas combustion research, and at developing an understanding of the mechanisms of ignition, catalytic combustion, and flame chemiluminescent emission of natural gas. In a collaborative effort with researchers from Yale University, LIF measurements were made of O atoms, OH radicals, and temperatures above a catalytically augmented gas-phase combustor, showing the influence of catalytic surfaces at various mixing ratios. Low pressure burner measurements show that, for OH and CH chemiluminescence, simple pressure scaling is inadequate and multiple mechanisms are probably present. Transition state/RRKM theory calculations to codify parameters for extrapolation of rate constants with temperature and pressure were systematically begun for abstraction, decomposition, and activation reactions important in natural gas combustion.

0350 Storage

REFER ALSO TO CITATION(S) 39213

39219 (MC—071986) Natural gas storage in Ontario. (Monenco Consultants Ltd., Rexdale, Ontario (Canada)). Jul 1986. 232p. (MICROLOG—88-02117). Ontario Ministry of Energy, Municipal and Commercial Programs, 56 Wellesley St. West, Toronto, Ont., Canada M7A 2B7; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

The operation of underground natural gas storage reservoirs in Ontario dates from 1915. Currently there are fifteen operating pools in Ontario. The filling of these reservoirs from pipelines takes place generally during April to October with removal of the gas during the heating season, November to March. The balancing of supply and demand provided by the storage facilities, along with export market flexibility, allows the supply system to operate at virtually full capacity throughout the year. In addition, a liquefied natural gas (LNG) storage facility which has operated for over eighteen years near Sudbury is used to supply short-duration peak volume requirements during the winter, utilizing gases delivered during the warmer months. Another LNG facility near Toronto has been proposed and is evaluated. The requirements for additional underground storage capacity will be provided over the medium term by increasing the operating pressure of current reservoirs (delta-pressuring) and developing depleted pinnacle reef gas production reservoirs. Other longer term storage potential exists in aquifer cavities. The benefits of underground gas storage is indicated by analyzing transportation system costs which would be incurred if no seasonal storage were available. When these costs are allocated to gas customers, the resulting impact appears to be greatest on the low load factor, seasonal user of gas. A preliminary analysis of the capability of underground storage to respond to a disruption in western gas supply indicates that all essential gas services could probably be met for at least the period required to repair physical damages. 18 refs., 18 figs., 16 tabs.

39220 (SV-UK—1987-4) Study of a water curtain around a gas store in rock. Gasproject G2, 1987. Rehbinder, G.; Karlsson, R.; Dahlkild, A. (Swedish State Power Board, Vaellingby). 26 Jan 1987. 63p. NTIS (US Sales Only), PC A04/MF A01. Order Number DE88753757/JAW.

When gas is stored in a rock cavern at a pressure exceeding the pressure of the water surrounding the cavern, there is a risk of the gas seeping out into the rock. Artificial increase of water pressure can prevent this and water will flow into the cavern. Pressurized holes round the cavern can contribute to the effect. Experiments show the relations of the dimensionless parameters in order to make the principle of the 'water curtain' work. The parameters are the quotients of the pressure of storage space and curtain holes, respectively, the quotients of the diameter of the space and the distance between the space and holes as well as the number of the holes, respectively. The investigation consists of a theoretical study and laboratory experiments. The idealizations are discussed. (authors).

39221 (TRITA-HYD—86-03) Source flow near a cavity with constant pressure in a porous medium. Dahlkild, A.A. (Royal Inst. of Tech., Stockholm (Sweden). Dept. of Hydromechanics). Aug 1986. 21p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88753762/JAW.

The flow of water outside a cavity in a porous medium is considered. Inside the cavity gas is stored at high pressure. If a number of point sources of water is placed outside the cavity, leakage of gas into the porous medium can be prevented. The minimum value of the total source strength needed is computed for some different configurations of sources. In the two-dimensional case the sources are placed symmetrically on a circle outside the cavity. The value of the minimum flux was found to decrease as the number of sources increased but it was always larger than the flux that would have left the cavity if the sources had been absent. In the three-dimensional case some simple configurations of the sources were investigated. The minimum value of the total source strength does not always decrease with an increasing number of symmetrically placed sources. The spatial distribution of sources is of critical importance.

04 OIL SHALES AND TAR SANDS

REFER ALSO TO CITATION(S) 39046

39222 (OSTF—031988) Outlook on the oil sands No. 2: Canada's unique opportunity. (Oil Sands Task Force, Edmonton, Alberta (Canada)). Mar 1988. 17p. (CE—01629). Alberta Chamber of Resources, 10235 - 101 St., Ste. 1410, Edmonton, Alta., Canada T5J 3G1; $3.75 CAN.

The purpose of this paper is to review options for meeting Canada's oil supply production, identify conditions that affect development of Canada's unconventional oil resources, show the true potential for the Athabasca oil sands, and suggest an action plan that is in Canada's best interests. Today Canada produces slightly more oil than it consumes, but the production capability of Canada's domestic oil supply is declining rapidly. New sources of supply will be needed to offset the decline. Production from conventional oil sources will not be able to keep up with the decline. Heavy oil is not a significant factor in the long term. Proven frontier reserves will only be able to meet Canada's total supply needs for three years. Oil sands contain the only reserves capable of meeting Canada's long term needs. Requirements for developing them are quite different than they are for conventional oil: there is a significant role for government, and projects tend to be quite large and capital intensive with long lead times. A long term energy policy is needed that favours orderly development of Canada's competitive assets. Such a policy is needed to offset influences of the international market. Canada will need production from all domestic sources if it is to maintain long term self sufficiency in oil supply. Conventional oil production should be encouraged as long as it is competitive. Oil sands are also competitive for meeting Canada's long term needs and should be developed on a continuing basis. 12 refs., 6 figs., 11 tabs.

39223 (OSTF—101987) Outlook on oil sands No. 1: Canada's unique opportunity. (Oil Sands Task Force, Edmonton, Alberta (Canada)). Oct 1987. 10p. (CE—01628). Alberta Chamber of Resources, 10235 - 101 St., Ste. 1410, Edmonton, Alta., Canada T5J 3G1; $3.75 CAN.

It is believed that Alberta's oil sands should play an important role in Canada's energy future, as they are the only resource with sufficient developable reserves to meet Canada's long term needs. Unfortunately, report from the National Energy Board (NEB) and others suggest that production from the oil sands is very expensive. They quote supply side costs of $32 to $52 per barrel, which suggests that development of the oil sands should be deferred. This paper attempts to show that the NEB's understanding of the cost of developing oil sands is incorrect, and that conclusions which justify delaying orderly development of the oil sands are not in Canada's best interests. The purpose of this paper is to explain the rationale behind the NEB outlook, to show the true potential for the oil sands, and to suggest an action plan which is in the best interests of Canada. It is concluded from analuysis of current practices and possible improvements that the information provided by NEB about the cost of developing the oil sands is incorrect, probably because costs were obtained by looking at historical data from traditional projects. The NEB assessment did not reflect current costs which are more favourable. Nor did they reflect current costs which are more favourable. Nor did they reflect the even better costs possible in the future, which are more relevant for planning the source of Canada's future oil supply. Therefore it is believed that production from the Athabasca oil sands is competitive, that development would bring many benefits, and that Canada should proceed immediately with orderly development of this abundant and unique asset. 6 refs., 5 tabs.,

0404 Oil Production, Recovery, And Refining

REFER ALSO TO CITATION(S) 39148, 40605

39224 (OSTF—091987) A regional upgrader for Athabasca Oil Sands. (Oil Sands Task Force, Edmonton, Alberta (Canada)). Sep 1987. 22p. (CE—01627). Alberta Chamber of Resources, 10235 - 101 St., Ste. 1410, Edmonton, Alta., Canada T5J 3G1; $3.75 CAN.

This report summarizes the present status of Athabasca oil sands surface mineable projects, and outlines of a new concept which involves the establishment of a regional bitumen upgrader in Alberta as a common processing facility for accepting feedstock from a number of satellite bitumen production facilities. The concept decouples bitumen processing from bitumen production. The report also covers recent work on representative costs for oil sands development which point out the economic viability of oil sands projects. Finally, the potential effects of the proposed tax regula-

tions on future oil sands projects are briefly presented. It is concluded that the two commercial mineable oil sands operations have been performing at high levels of productivity and efficiency. Oil sands projects are capital intensive, but new concepts, smaller scale and new technologies may significantly reduce the initial capital requirement. New oil sands projects incorporating some of the new concepts and technologies should be able to produce synthetic crude oil at a supply cost of $30/bbl or lower. The proposed tax regulations have a negative impact on oil sands developments. 1 fig., 2 tabs.

39225 **(OSTF—111986) The regional upgrader and the satellite production facilities concept.** (Oil Sands Task Force, Edmonton, Alberta (Canada)). Nov 1986. 22p. (CE—01632). Alberta Chamber of Resources, 10235 - 101 St., Ste. 1410, Edmonton, Alta., Canada T5J 3G1; $3.75 CAN.

A proposal has been prepared that outlines a concept for development of Alberta's unconventional hydrocarbon resources. The concept proposes the establishment of a regional upgrader utilizing feedstock produced from a number of individual satellite production facilities. The regional upgrader will function as a common processing unit capable of accepting feedstock from a number of viable mineable oil sand and/or in-situ satellite production facilities. It is believed that this concept of development contains a number of advantages worthy of further investigation. It allows development to proceed in smaller, more manageable component pieces. Reduced capital investment requirements allow both large and small resource leaseholders the opportunity to develop their properties as potential satellite production facilities. Feedstock supply risk to the regional upgrader will be minimized. An alternative Canadian/Alberta market for mineable oil sand bitumen and in-situ production will be created, which will ensure the continued development of Alberta's unconventional hydrocarbon resources and provide critically needed employment opportunities in Alberta. This paper contains additional pertinent information supporting the concept and addresses the following: a general introduction of the concept, including background information and the rationale, opportunities that would exist if the concept was adopted and developed, required infrastructure and suggested configurations for concept development, listing of issues to be addressed for the concept, and a recommended course of action for further investigation and development. 1 fig., 2 tabs.

39226 **(OSTF—111987) Regional upgrader and satellite production facilities preliminary evaluation.** (Oil Sands Task Force, Edmonton, Alberta (Canada)). Nov 1987. 149p. (CE—01634). Alberta Chamber of Resources, 10235 - 101 St., Ste. 1410, Edmonton, Alta., Canada T5J 3G1; $3.75 CAN.

A concept has been proposed for a regional upgrader in Alberta with a series of smaller scale production satellites supplying oil sand bitumen. This report is a collection of the results of a detailed study for evaluating the economic viability of the concept. It combines the technical and non-technical aspects of the concept as well as the potential economic and social benefits that could be derived from its implementation. The study involves the preliminary evaluations of the mining/extraction and in-situ production modules, the required pipeline network and an upgrader module. In order to establish the economic significance of various factors such as location, size and integration, the upgrader module has been evaluated within the context of four different scenarios. The conclusions of this preliminary evaluation are encouraging. The evaluation confirms that the regional upgrader concept in relation to the more conventional integrated approach is viable. Based on the supply cost method of economics which includes a 10% real, built-in rate of return, the cost of synthetic crude (SCO) production through the applications of the concept would be in the range of $29.11 to $33.66 per barrel of SCO. This range reflects the cost of the product delivered in Edmonton and expressed in 1987 dollars. The supply costs do not show significant difference between two different types of bitumen production modes. The effect of size difference is significant; however, this is partly attributable to pipeline size, and larger capacity requires larger capital. The upgrader concept is not currently economical under strictly economic criteria, but is attractive if social benefits are considered. 9 refs., 17 figs., 48 tabs.

39227 **(OSTF—121987) Alternatives for processing Canadian heavy oil and bitumen.** (Oil Sands Task Force, Edmonton, Alberta (Canada)). Dec 1987. 24p. (CE—01631). Alberta Chamber of Resources, 10235 - 101 St., Ste. 1410, Edmonton, Alta., Canada T5J 3G1; $3.75 CAN.

The concept of a regional upgrader is proposed as a means of promoting oil sands development in Alberta. Heavy hydrocarbons produced from production sites would be transported for upgrading at one regional plant. To date, small scale production of bitumen has been sold without upgrading but the time is coming when the bitumen market will be saturated and the production of Alberta's heavy hydrocarbons will be constrained by the lack of upgrading facilities. The concept could provide an upgrading service for a number of these small producers. The studies to date have produced competitive social supply costs for bitumen produced by the satellite production facilities and processed at a regional upgrader. There are other alternatives, however, to a grass-roots upgrader for processing Alberta's heavy hydrocarbons. This paper reviews these options including upgrading capacity additions to the existing oil sands plants and refineries. The review points out the synergism that may exist in establishing additonal capacities at these plants. Further, it shows that the option of partial upgrading in various producing fields and then hydrotreating at a central plant is encouraging. However, the determination of true economics for these alternatives require site-specific evaluations. 7 refs., 1 tab.

39228 **(RPC—05011987) Circulating fluidized bed gasification of Minto coal and N.B. oil shale. Final report.** Robson, R.; Barua, S.K. (Research and Productivity Council, New Brunswick (Canada)). 5 Jan 1987. 42p. (MICROLOG—88-01560). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1. $0.34 CAN per page, $3.40 minimum; MF $10 CAN.

The objective of this study was to assess the potential of a novel pyrolysis scheme in which the combustion of the product char and pyrolysis of the fresh feed took place in alternate cycles. The feedstock to be tested was a mixture of New Brunswick oil shale and high sulfur Minto coal. The pyrolysis program was not as successful as anticipated due to difficulties in controlling the operating parameters. As a result, the pyrolysis cycle could not be sustained for an extended period of time and no oil was generated. Efforts were dircted towards the gasification of the coal and oil shale. The objectives were to optimize the gas quality and sulphur capture by the oil shale. The reactor system was operated reliably with the coal and oil shale under a wide range of operating conditions. The calorific value of the gas ranged from 0.44 to 0.95 MJ/m/sup 3/. The former was obtained with coal only, while the latter with 1:3 coal-oil shale mix. Corresponding sulphur capture ranged varied from 0% to 71%. None of the independent variables investigated, except the ratio of coal-oil shale mix, showed any significant effect on the gas quality. The calorific value of the gas was found to increase with the increase in the proportion of oil shale in the feed. Similar trend was also observed for sulphur capture. 6 refs., 8 figs., 15 tabs.

0405 Properties And Composition

REFER ALSO TO CITATION(S) 39203, 39204, 39997

39229 **(UCID—16986-88-1) Oil shale quarterly report, January-March 1988.** Lewis, A. (Lawrence Livermore National Lab., CA (USA)). Jun 1988. Contract W-7405-ENG-48. 5p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88012443/JAW.

This report addresses the effect of a thermal gradient on product evolution profiles obtained by nonisothermal batch pyrolysis, and effect of oxidized shale yield. It appears that oxidized shale provides an effective heat carrier in solid-recycle retorting, but its presence inhibits attaining the full yield potential of the shale. 2 figs.

39230 **Wettability and adsorption characteristics of crude-oil asphaltene and polar fractions.** Crocker, M.E.; Marchin, L.M. (Natl. Inst. for Petroleum and Energy Research (US)). *Journal of Petroleum Technology;* 40: No. 4, 470-474(Apr 1988).

This study relates the chemical composition of the polar compounds of crude oil to the wettability of rock/oil/brine systems. Adsorption properties of polar and asphaltene fractions were evaluated to determine their effects on wettability. Polar compound fractions were found to cause an oil-wet state on Berea sandstone, but the effects were not a function of the polar-fraction concentration. The concentration of nitrogen/sulfur compounds in six crude-oil polar fractions correlated with the wettability of the polar fractions on Berea sandstone. Langmuir-type adsorption on Berea sandstone was observed in adsorption studies of the asphaltene and polar fractions. Additional analysis with brien-saturated Berea sandstone resulted in adsorption values up to three times less than that for dry Berea. The amount of polar fraction adsorbed on brine-saturated berea sandstone correlated with crude-oil wettability.

0408 Marketing And Economics

REFER ALSO TO CITATION(S) 40053, 40057

39231 **(OSTF—071987) Representative costs for mineable oil sands projects.** (Oil Sands Task Force, Edmonton, Alberta (Canada)). Jul 1987. 11p. (CE—01630). Alberta Chamber of Resources, 10235 - 101 St., Ste. 1410, Edmonton, Alta., Canada T5J 3G1; $3.75 CAN.

The paper has assembled and assessed representative costs for mineable oil sands projects in Alberta. The data encompass projects that produce bitumen, stand-alone upgraders that produce synthetic oil, and integrated projects that produce bitmen and synthetic oil. Simple supply side costs are also indicated. Recent operating experience at Syncrude and Suncor suggests operating costs (cost and sustaining capital) of $14 to $16/bbl for an integrated project. They are forecasting that these costs are sustainable in real terms. Further cost reductions are anticipated for projects that can incorporate improved technology. Tabulated results show the factors with a potential to significantly reduce supply side costs for oil sands projects. The feasibiltiy of achieving savings for some of the factors affecting mining are site- and equipment-specific, and that there is little economy of scale for extraction at rates of 15,000 bbl/day or larger. Descriptive comments are provided to the numerical data presented and include comments on the use of supply side cost analysis. 5 figs., 2 tabs.

39232 **(OSTF—081987) Athabasca Oil Sands, opportunities for economic growth.** (Oil Sands Task Force, Edmonton, Alberta (Canada)). Aug 1987. 42p. (CE—01633). Alberta Chamber of Resources, 10235 - 101 St., Ste. 1410, Edmonton, Alta., Canada T5J 3G1; $3.75 CAN.

This paper summarizes the present status of the surface mineable project in the Athabasca oil sands and outlines of a new concept which involves the establishment of a regional bitumen upgrader in Alberta as a common processing facility for accepting feedstock from a number of satellite bitumen production facilites. The concept decouples bitumen processing from bitumen production. Recent work on representative costs for oil sands development is described, which point out the economic viability of oil sand projects. Finally, the potential effects of the proposed tax regulations on future oil sands projects are briefly presented. Included are copies of slides used in an oral presentation of this paper, repeating its content in outline form. 1 fig., 2 tabs.

0409 Waste Research And Management

39233 **(ZE—14011987) Development of a process for the treatment of oil/water/mineral emulsions from in-situ bitumen/heavy oil recovery operations. Final report.** (Zenon Environmental, Inc., Burlington, Ontario (Canada)). 14 Jan 1987. 119p. (MICROLOG—88-02254). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1. $0.34 CAN per page, $3.40 minimum; MF $10 CAN.

The objectives of this study were to develop and optimize the process of emulsion destabilization by multivalent inorganic cations, followed by transfer of oil onto an inert filter, to develop and optimize a method of oil recovery and filter media regeneration, and to assess the technical and economic feasibility of treating wellhead emulsions from in-situ bitumen/heavy oil recovery operations using the developed methods. Experiments were conducted on heavy oil emulsions to investigate emulsion stability and methods for emulsion destabilization, notably coagulation, flocculation and filtering. A variety of coagulants and filter materials were evaluated. Experiments showed the emulsion was stable with respect to temperature and time, but could be destabilized by acid, and destabilized and separated by gravity using alum. Glass fiber and granular media showed, respectively, clean filtrate with low flow rate and low quality filtrate with high flow rates. Based on these results, a process using coagulation/flocculation followed by gravity belt filtration was proposed. The filtration step produces a clean filtrate with the filter cake suitable for recycle to a heater treater. The supernatant from the coagulation/flocculation process has a very low turbidity, low suspended oil levels, and requires no further reduction in oil content prior to hot lime softening. The cost comparison between the proposed and conventional treatment processes indicates that the proposed process is 17% less expensive. The proposed process is also better suited to handle upset conditions such as changes in feed oil content. 37 refs. 8 figs. 19 tabs.

0410 Environmental Aspects

REFER ALSO TO CITATION(S) 39178

39234 **(PB—88-196027/XAB) Air-pollution-control alternatives for shale-oil production operations. Final report, December 1985-December 1987.** Taback, H.J.; Goldstick, R.J. (KVB, Inc., Irvine, CA (USA)). Mar 1988. 574p. (KVB—72-807430-2031). NTIS, PC A24/MF A01.

This report consolidates, evaluates, and presents available air pollution emission data and air-pollution-control technology relevant to oil-shale production, for use by project developers in preparing environmental impact statements and permit applications under Clean Air Act and for local regulatory approval. Processes covered include: Subsurface and surface mining; Raw shale sizing and handling; In-situ and above-ground retorting; Spent-shale combustion and disposal; Product upgrading. Air pollution control technology covered includes traditional processes for NOx, sulfur compounds, particulates, VOCs, and CO control. Recently developed control processes not discussed elsewhere in the literature are also discussed and include: catalytic mufflers for NOx, VOC, and CO control on surface and subsurface vehicles; wet-scrubbing process (caustic/charcoal/sodium hypochlorite solution) for organic sulfur compounds; and staged combustion for NOx control of high-nitrogen fuels.

05 NUCLEAR FUELS

0501 Reserves, Exploration, And Mining

REFER ALSO TO CITATION(S) 40495, 41051

39235 **(INIS-BR—955) Radioactive ores from Agostinho field, Pocos de Caldas (MG), Brazil.** Fujimori, K. (Sao Paulo Univ. (Brazil). Inst. de Geociencias). 1974. 169p. (In Portuguese). NTIS (US Sales Only), PC A08/MF A01. Order Number DE88701609/JAW.

Aiming to characterize the radioactive minerals of Campo Agostinho, Pocos de Caldas - Brazil, the survey of all natural radiactive elements and their geochemical behaviors, decays and radioactive equilibrium was done. Several models of radioactive instability of the minerals or the radioactive samples were proposed to characterize the geochemistry and the mineralization of radioactive elements. The complete isotopic analysis of the elements was done by high resolution gamma spectrometry, using a Ge(Li) detector, at the temperature of liquid nitrogen, coupled to a multichannel analyser. The sample in radioactive equilibrium of Atomic Energy Co-

mission of United States - A.S. n.6, NBL - New Brunswick Laboratory, was considered as standard sample. Fluorite, zircons, pirite, molibinite, rutile, anatase, niobophyllite, and in small ratio (bellow 0.1%) uranothorianite, coffinite, pyrochlore, monazite and apatite. (M.C.K.).

39236 **(INIS-BR—1128) Torium partition and rare earths studies in particles from Morro de Ferro region, Pocos de Caldas, MG. .** Carlos, M.T. (Rio de Janeiro Univ. (Brazil). Inst. de Biofisica). [1988]. 25p. (In Portuguese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703229/JAW.

The researchs made in Radioisotopes Laboratory of IB - UFRJ (Biophysics Institute - Federal Rio de Janeiro University) during 1986 that included in the research program the geochemical transport in Morro de Ferro project was related. The thorium and rare earths elements association was characterized in the geochemical aspect using chemical fractionation methods through the experiments of selective lixiviation. (L.M.J.).

39237 **(INIS-mf—11232) Mining Pribram in science and technology. Proceedings of Session F - Applied geophysics.** Knez, J.; Lasansky, M. (eds.). (Vyvojova Zakladna Uranoveho Prumyslu, Pribam (Czechoslovakia)). 1987. 231p. (In Czech and English). (CONF-8710342—). NTIS (US Sales Only), PC A11/MF A01. Order Number DE88703055/JAW.

From Mining Pribram in science and technology; Pribram, Czechoslovakia (12 Oct 1987).

Conference proceedings are submitted comprising 19 papers of which 4 fall under the INIS scope. They concern radiometric monitoring of areas, specifically, the edition of geophysical maps of the Pribram area, new procedures in field measurement and processing of gamma spectrometric results, new emanation methods used by the Liberec Uranium Survey, and aerial gamma spectrometry in Western Bohemia and the Sumava area. (M.D.).

39238 (INIS-mf—11232, pp 59-72) **Edition of geophysical maps of 1:25,000 in Pribram.** Manova, M.; Salansky, K. (Geofyzika, Prague (Czechoslovakia)). 1987. (In Czech). NTIS (US Sales Only), PC A11/MF A01. Order Number DE88703055/JAW. (CONF-8710342—).

From Mining Pribram in science and technology; Pribram, Czechoslovakia (12 Oct 1987).

By the end of 1986, 8 sheets were processed covering the area within 20 km from Pribram within the project Edition of 1:25,000 geophysical maps. Regional methods were interpreted for all sheets, especially aerial magnetometry and radiometry (total gamma activity and partly also gamma spectrometry). High information efficiency was shown of the geophysical mapping in the basic scale for the solution of a number of geological problems of the subsurface and/or deeper geological structure in the geologically varied territory of the Pribram ore mining basin. The measurements could geologically be interpreted where they were based on geophysical work and the determination of the physical parameters of rocks. The measurement also confirmed that in the geologically complex conditions of the Pribram area, the 1:25,000 scale of aerial survey was mostly insufficient and the geophysical structures had to be specified by ground measurement in a scale of at least 1:10,000. However, the regional measurements in the 1:25,000 scale performed remain the most important information source for future geological and geophysical work, especially for purposes of basic geological and deposit surveys. Mineral raw material forecasts were shown for each sheet. (author). 17 refs.

39239 (INIS-mf—11232, pp 73-88) **New techniques in field measurement and gamma spectrometry results processing.** Anton, J.; Vesely, V. (Uranovy Pruzkum, Liberec (Czechoslovakia)). 1987. (In Czech). NTIS (US Sales Only), PC A11/MF A01. Order Number DE88703055/JAW. (CONF-8710342—).

From Mining Pribram in science and technology; Pribram, Czechoslovakia (12 Oct 1987).

Continuous measurement during slow walk along the profile while carrying the probe by hand and reading out the measured values at the end of the measuring interval is the method of mapping and measuring complex regional profiles. The method was compared with that of point measurement used so far. The new method shows a smaller error of uranium and potassium determination while its poorer geometrical conditions during measurement represent a constraint. The application of data processing allows calculating the radioactive element concentration fields using statistical methods. (M.D.). 2 refs., 4 tabs., 5 figs.

39240 (INIS-mf—11232, pp 89-104) **New emanation method in Uranovy Pruzkum Liberec.** Cizek, P.; Jandejsek, L.; Kulajta, V.; Merta, J.; Toser, Z. (Uranovy Pruzkum, Liberec (Czechoslovakia)). 1987. (In Czech). NTIS (US Sales Only), PC A11/MF A01. Order Number DE88703055/JAW. (CONF-8710342—).

From Mining Pribram in science and technology; Pribram, Czechoslovakia (12 Oct 1987).

Two new emanation methods are described also called exposure methods. In measurement, soil air is not sampled. Suitable foils are placed in sealed shallow bores and are evaluated following their removal. The alpha track technique uses the principle of several weeks-long exposure of a polymer foil used as a solid state track detector. The alpha card technique uses the measurement of surface alpha activity of radon daughters captured on a collection foil. The history is described of the techniques and their applications. The new emanation methods are not immediately dependent on the petrographic type of the rock environment. They can be used where deep gamma logging cannot be applied and in weak deposit prospecting. (M.D.). 4 refs., 8 figs.

39241 **(PER—158) Uranium potential of the Bushveld igneous complex. A critical reappraisal.** Andreoli, M.A.G.; Hart, R.J.; Brynard, H.J.; Camisani-Calzolari, F.A.G.M. (Atomic Energy Corp. of South Africa (Pty) Ltd., Pretoria; Pretoria Univ. (South Africa)). Jun 1987. 47p. (GEA—748). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703467/JAW.

A review of published literature supported by field observations on the uranium potential of the Bushveld Complex indicates that this geological region may host deposits with reserves in the range of a few thousand tons U/sub 3/O/sub 8/. The possibility that the Bushveld Complex or its cover rocks hosts, or has ever hosted in the past, giant uranium deposits such as those of Olympic Dam, Key Lake, Jabiluka or Rossing is considered to be unlikely. The potential for volcanogenic, caldera-type deposits in the Rooiberg Felsites remains at present untested. Recommendations for research currently sponsored by the AEC at the University of Pretoria are presented.

0504 Feed Processing

39242 **(DOE/EA—0319) Fuel Production Facility, Building 225-H, Savannah River Plant: Environmental assessment.** (USDOE Assistant Secretary for Defense Programs, Washington, DC). Nov 1986. 41p. NTIS, PC A03;3. Order Number DE88008315/JAW.

This document assesses the potential environmental consequences from the construction and operation of a new Fuel Production Facility (FPF) at the Savannah River Plant (SRP), Aiken, SC. The new FPF is to be constructed in H-Area to provide for SRP recycling of uranium and eliminate shipments of liquid uranyl nitrate between SRP and Oak Ridge, Tennessee. The National Environmental Policy Act (NEPA) requires the assessment of environmental consequences of all major Federal actions that may affect the quality of the human environment. This document describes the environmental impact of constucting and operating the FPF and considers alternatives. The new facility will convert enriched uranyl nitrate solution to uranium oxide with an Onsite Uranium Recycle (OSUR) process. The uranium oxide will then be fabricated into fuel billet cores using a Powder Metallurgy (PM)-based process. The new facility will reduce fuel manufacturing costs, increase reactor productivity, reduce waste costs, improve personnel safety, and eliminate offsite shipments of enriched uranium solution and the risk of transportation accidents. 10 refs., 5 figs., 8 tabs.

0505 Uranium Enrichment

REFER ALSO TO CITATION(S) 39410, 40496

39243 (CEA-CONF—9309) Physical aspects of the isotope separation by laser induced selective ionization, with emphasis on model analysis. Soubbaramayer. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Dept. de Physico-Chimie). 1987. 124p. (CONF-870782—). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88753924/JAW.

From Workshop on separation phenomena in liquids and gases; Darmstadt, F.R. Germany (20 Jul 1987).

Basic studies on the process of isotope separation by laser-induced selective ionization have started about fifteen years ago. In the present time, the interest in this process is considerably increased since some countries' decision of funding a substantial R and D program with the ultimate goal of a possible industrial production of reactor grade uranium in the late nineties'. Several hundreds of professionals in the world are now exploring the science of the process, the components technology and the optimal way of industrialization. This review paper is restricted to the physical aspects of the process as they can be understood from the published literature. 55 refs.

39244 (CONF-880558—) Uranium hexafluoride: Safe handling, processing, and transporting: Conference proceedings. Strunk, W.D.; Thornton, S.G. (eds.). (Oak Ridge Gaseous Diffusion Plant, TN (USA)). 1988. Contract AC05-84OT21400. 239p. NTIS, PC A11/MF A01;1; GPO Dep. Order Number DE88010460/JAW.

From Uranium hexafluoride--safe handling, processing, and transporting conference; Oak Ridge, TN, USA (24 May 1988).

This conference seeks to provide a forum for the exchange of information and ideas of the safety aspects and technical issue related to the handling of uranium hexafluoride. By allowing operators, engineers, scientists, managers, educators, and others to meet and share experiences of mutual concern, the conference is also intended to provide the participants with a more complete knowledge of technical and operational issues. The topics for the papers in the proceedings are widely varied and include the results of chemical, metallurgical, mechanical, thermal, and analytical investigations, as well as the developed philosophies of operational, managerial, and regulatory guidelines. Papers have been entered individually into EDB and ERA. (LTN)

39245 (DOE/EA—0279) Environmental assessment on proposed revision to the uranium enrichment services criteria. (Department of Energy, Washington, DC (USA). Div. of Electric Energy Systems). 1 Jan 1986. 23p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88008275/JAW.

There have been a number of revisions to the Uranium Enrichment Services Criteria. When the original criteria were adopted, the US Government held a virtual monopoly in the world enrichment market. The original Criteria were written in large measure to protect customers from the Government's monopolistic position. In today's competitive market, these Criteria are not appropriate, since customers no longer need protection from the Government's monopolistic position. Rather, the Government needs the ability to effectively compete with other suppliers. DOE proposes to revise the current Uranium Enrichment Services Criteria to explicitly address the realities of today's highly competitive market for enriched uranium. The proposed Criteria are designed to provide the flexibility to DOE to remain competitive in the future. Attachment 1 contains a draft of the proposed revised Criteria.

39246 (DOE/EH—8013173) Environment, safety and health report for the Portsmouth Gaseous Diffusion Plant: Supplement. (USDOE, Washington, DC). 1 Jul 1988. 6p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88013173/JAW.

The primary mission of the Portsmouth Gaseous Diffusion Plant, located in Piketon, Ohio, and administered by the Oak Ridge Operations Office, is to produce enriched uranium to meet commercial and government needs, both domestic and foreign. The following key areas are identified for ES and H (Environment, Safety and Health) corrective actions at the Portsmouth site: Minimization of Air Pollution Emissions; Full Compliance with the Clean Water Act; Protection of Personnel and Environment from Hazards, Radioactive, and Mixed Wastes; Remedial Actions at Hazardous Waste Disposal/Spill Sites; Nuclear Facility Safety Training Requirements; and Protection of the Safety and Health of the Public and Employees. Resource projections are provided. 3 tabs.

39247 (JAERI-M—88-005) Dynamic behavior and control of product enrichment in a centrifuge cascade. A study of the process simulation as a basis of safeguards design. Okamoto, Tsuyoshi; Suzuki, Atsuyuki; Nishimura, Hideo. (Japan Atomic Energy Research Inst., Tokyo). Feb 1988. 22p. (In Japanese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88753623/JAW.

It was agreed as a conclusion of the HEXAPARTITE project that a limited frequency unannounced access (LFUA) inspection should be carried out in a centrifuge type enrichment plant as a basic safeguards approach. It might be adopted at a large scale, future commercial enrichment plant, too. Application of the LFUA approach to such a plant, however, should be fully investigated because the plant will have not only a larger capability of enriching uranium 235 but also a more sensitive information to be protected from the commercial and nonproliferation viewpoint. As a part of a design study on the safeguards approach for a model commercial plant, a study of process simulation of the plant has been carried out. This report describes a result of the study. When a commercial uranium enrichment plant is constructed, a nuisance problem arises; What kind of products should be produced from the plant in order to match a wide range of nuclear fuel enrichment requirements for light-water power reactors. In this report, a reasonable solution to such a problem is investigated. At first, a transient analysis of start-up for a model centrifuge cascade is made by using the dynamic equations, which were so developed as to be able to accurately compute interstage flow rates and enrichment in a transient state. Then it is investigated how wide in its acceptable range the product enrichment can be controlled by regulating cascade characteristic parameters such as cascade cut, recycle flow rate and cascade feed flow rate, and as a result an information about the optimal regulating mode is brought out. As a result of this study, it has become clear that the specific requirements of a customer are almost fulfilled with only one type of unit cascade system if 10 % loss of cascade efficiency is allowed in the plant operation.

39248 (K/ITP—121/R1) Overview of the U(III)-U(IV) chemical enrichment process. (Oak Ridge Gaseous Diffusion Plant, TN (USA)). Apr 1988. Contract AC05-84OT21400. 39p. (CONF-8804102—1). NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88009052/JAW.

From Informal chemical enrichment process discussions; Tokyo, Japan (11 Apr 1988).

CEA representatives (Lerat and Lorrain) contributed a chapter to a book on the CHEMEX process ("Solvent Extraction and Ion Exchange in the Nuclear Fuel Cycle" by Logsdail and Mills of the United Kingdom's Atomic Energy Research Establishment in Harwell, England). This 1985 paper describes the basic element of the CHEMEX process as being a 1200 mm diameter by 30 meter high pulse column with an isotopic separation power of 15,000 SWUyear. A simple calculation would seem to indicate a volumetric efficiency of 442 SWUyearm^3. The basic industrial model was described as having a rated capacity of 500,000 SWUyear consisting of two overlapped, twenty-column cascades. Ninety tons of product uranium at 3.5% assay would be produced per year from natural feed with tails assay being 0.18%. This paper also gives substantial detail on materials of construction and auxiliaries such as the electrolyzer. Costs are described briefly. The plant's material balance for a 500,000-SWUyear facility yields an effective volumetric efficiency of about 368 SWUyearm^3. The January 1987 Nuclear Fuel quoted a CEA source as saying that the plant performed 30% better than forecast due to "a lot of technical progress" at the PP35 pilot plant at Pierrelatte. The CEA is preparing to commission a new facility at Grenoble called PL81 which includes at reduced scale, a complex CHEMEX assembly capable of producing 3.5% assay uranium. This new pilot plant is reported to contain 16 exchange columns, each 40 meters high, specifically designed for op-

eration with improved process chemistry. Tests at this new facility are expected to feature a modified solvent. A run-in period will last about nine months, with nominal operation lasting about a year, and ending in late 1988. At that time it is planned to stop CHEMEX experiments with reassignment of all but a skeleton technology watch team. Currently slightly under 100 people are assigned to CHEMEX. 24 refs.

39249 (K/ITP—168) Liquid-phase compositions from vapor-phase analyses: 5, Details of adaptation of the program of Prausnitz et al. to systems containing UF_6. Davis, W. Jr.; Cochran, H.D. (Oak Ridge Gaseous Diffusion Plant, TN (USA)). Jun 1988. Contract AC05-84OT21400. 32p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88013524/JAW.

The program of J.M. Prausnitz and his associates for computer calculations is being tested for its ability to calculate liquid-phase compositions from vapor-phase compositions wherein UF_6 would be the principal component in terms of weight percent present. This report describes the adaptation of the Prausnitz program to the main frame (IBM) computers at the Oak Ridge facilities of the Department of Energy. The program consist of 30 subroutines plus various other filed of information as driver programs, libraries of thermodynamic data on pure components, parameters describing the interactions between pure compounds, and procedures for calculating binary interaction parameters for the UNIQUAC equation used to describe the excess Gibbs free energy of solutions based on experimental data. In this report, the various files are defined and the methods for their use described. 9 refs. 4 tabs.

39250 (KFK—4315) Stabilization of the UF_6-distribution and the isotopic gradient of a separation nozzle cascade for uranium enrichment. Bley, P.; Coelho, J.S.; Hein, H.; Souza, A.A. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Kernverfahrenstechnik; Karlsruhe Univ. (T.H.) (Germany, F.R.). Fakultaet fuer Maschinenbau). Feb 1988. 50p. (In German). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88753830/JAW.

Dissertation submitted to Karlsruhe Univ. (T.H.) by H. Hein.

The separation nozzle method of uranium enrichment uses as process gas a mixture of uranium hexafluoride (UF_6) and a light auxiliary gas (H_2 and He, respectively). In order to compensate in a separation nozzle cascade for the pronounced transport of the light auxiliary gas to the top of the cascade, most of the auxiliary gas stream is extracted at the top of the cascade by means of cryo-separators operating in a cyclic mode and is recycled to the bottom of the cascade, while a UF_6 feedback of the UF_6 removed must be continuously returned to the top of the cascade through a buffer tank. Under the operating conditions defined in the light of economic assessments, false flows of UF_6 are carried to the bottom of the cascade, where they must be dissipated quickly. False flows of UF_6 generated at the top of the cascade pass through the entire cascade and, consequently, can greatly reduce the separating power. In a ten-stage pilot plant (Belo Horizonte, Brazil) the changes in UF_6 distribution in the cascade and in the ^{235}U isotopic gradient due to such false flows of UF_6 were studied. Even in the presence of massive false flows of UF_6 the required stable and uniform UF_6 distribution is ensured at all stages solely by controlling the UF_6 content in the bottom stage by means of the UF_6 tails flow at the bottom of the cascade. The ^{235}U isotopic gradient, which is a function of UF_6 transport, must be kept at its preset level for maximum separation power. For this purpose, a control system for the transport of UF_6 has been developed in which the tails flow is used as a control variable and the UF_6 feedback flow from the buffer tank at the top of the cascade is used as a manipulated variable. (Abstract Truncated)

0507 Fuels Production And Properties

REFER ALSO TO CITATION(S) 39270, 39761, 40496, 40581, 41927, 41970, 41972, 41980, 41981, 41982, 41983, 41985, 41991, 41992, 41994, 41995, 41996, 41997, 41999, 42000, 42001, 42002, 42003, 42004, 42006

39251 (DPST—88-248) Tin/oil lubricant for coextrusion of aluminum clad reactor fuel elements. Peacock, H.B. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). 25 Jan 1988. Contract AC09-76SR00001. 23p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88010892/JAW.

Tests carried out in the Fabrication Laboratory of SRL and in the Plant indicate that tin powder for the oil-base, 300-Area, extrusion lubricant. Commercial tin powder contains some lead impurities. Leach tests of commercial tin powder, however, show that the lead content in the leachate is below the drinking water standard and a hazardous classification is not required. The tin/oil lubricant does not appear to meet the EPA requirements for hazardous materials given in the "California List" and therefore is not banned for long-term land storage. 4 refs., 13 figs., 4 tabs.

0508 Spent Fuels Reprocessing

REFER ALSO TO CITATION(S) 39428, 40289

39252 (CEA-CONF—9129) Applications of plutonium dioxide oxydizing dissolution process. Lecomte, M.; Bourges, J.; Madic, C. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. de Genie Radioactif). 1987. 9p. (In French). (CONF-870801—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88753882/JAW.

From International conference on nuclear fuel reprocessing and waste management (RECOD '87); Paris, France (24 Aug 1987).

Laboratory investigations having demonstrated the outstanding effectiveness of Ag/sup 2+/ ions for the dissolution of plutonium dioxide in nitric medium, two applications of this method were developed at the CEA: dissolution of off-standard PuO/sub 2/, recovery of the plutonium contained in ashes produced by incineration of solid wastes. With respect to PuO/sub 2/ dissolution, the parametric investigation of the electrogeneration of Ag (II) and of its reaction with PuO/sub 2/, led to the development of a process and of the equipment required for its implementation. The prototype facility used to dissolve in 4 hours 1 kg of plutonium, in oxide form, was built and tested in the laboratory. This equipment was used to dissolve 30 kg of plutonium oxide in batches of about 700 grams. An in-line spectrophotometric method was developed for process control. The application of this process to the recovery of plutonium from incineration ash is currently being developed. Tested on the scale of about 1 kg of ash, the process helps to recover the plutonium with yields higher than 98 %.

39253 (CEA-CONF—9130) Simulation of the chopping of irradiated PWR rod bundles. Colas, J.; Pellier, R.; Philippe, M.; Blanchard, R.J. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. de Genie Radioactif; CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France). Inst. de Recherche Technologique et de Developpement Industriel (IRDI)). 1987. 8p. (In French). (CONF-870801—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88753883/JAW.

From International conference on nuclear fuel reprocessing and waste management (RECOD '87); Paris, France (24 Aug 1987).

Inactive testing of prototypes for cutting, dissolution, clarification in the head end processes for reprocessing PWR spent fuels requires a previous characterization of the product obtained by cutting spent fuel element clusters and the realization of a simulated fuel. Cutting force is determined for cutting tool sizing. Tests on rods or rod bundles show that irradiated zircaloy 4 is best represented by steel XC35 and UO/sub 2/ by cordierite. Geometrical characteristics of spent fuel after cutting are briefly presented.

39254 (CEA-CONF—9132) Annular pulse column: Results of tests. Coste, J.A.; Mathieu, D.; Bernier, G. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. de Genie Radioactif). 1987. 7p. (In French). (CONF-870801—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88753884/JAW.

From International conference on nuclear fuel reprocessing and waste management (RECOD '87); Paris, France (24 Aug 1987).

This type of column presents a favourable geometry without cross section limitations, hence of capacity. Tests are presented on the first annular demonstration column with diameters of 450 and 290 mm. in the first extraction cycle for reprocessing nuclear fuels. Different types of column packings are tested.

39255 (CEA-CONF—9135) Main characteristic of high level solid wastes from the head-end of the Purex process. Gue, J.P.; Isaac, M.; Malet, G.; Courtois, G.; Lesauvage, M. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. de Genie Radioactif; Compagnie Generale des Matieres Nucleaires (COGEMA), Centre de la Hague, 50 - Cherbourg (France)). 1987. 4p. (In French). (CONF-870801—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88753886/JAW.

From International conference on nuclear fuel reprocessing and waste management (RECOD '87); Paris, France (24 Aug 1987).

Hulls and dissolution residues are the main high-level radioactive wastes recovered at the head end of the Purex process. Transuranium element content of these solid wastes will define management, conditioning and storage. Following laboratory results actual wastes from the La Hague reprocessing plant UP2 are characterized. Results of the Coquenstock operation: characterization of whole assembly hulls produced by industrial reprocessing of PWR fuels are examined after cutting and dissolution at the HAO plant (high activity oxide). For fines or dissolution residues laboratory results are described and compared to those obtained recently with HAO plant after clarification of the solution.

39256 (CEA-CONF—9285) Refurbishing and new capabilities of the extraction cycles of the Marcoule pilote plant. Charvillat, J.P.; Legras, P.; Le Bouhellec, J. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. de Genie Radioactif). 1987. 16p. (CONF-8706249—). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88753909/JAW.

From EXTRACTION '87: meeting on solvent extraction techniques; Dounreay, UK (22 Jun 1987).

The fuel reprocessing of the Phenix fast reactor started in 1977, in the Marcoule pilot facility fed with the first enriched UO/ sub 2/ core (2.3 t of fuel) then with the second UO/sub 2/ - PuO/ sub 2/ Phenix-core II (6.5 t of U + Pu metal). Following a brief description of the Pilot Facility, the main characteristics of the extraction flowsheets are further detailed. The performances of the reprocessing line are discussed using the observed decontamination factors and recovery yields. It is effectively shown that a good $\beta\,\gamma$ decontamination can be reached with only two extraction cycles and a second cycle partition. The process unit revamping increases the experimental possibilities such as the first cycle U/Pu partition realization and the comparison of various extraction contactors, packing types, pulsed columns operations, double acidity or reflux cycles.

39257 (CEA-CONF—9303) Program for the improvement of electronic telemanipulators for use in reprocessing plants No. 193. Guay, P.; Streiff, G.; Collombat, J.C.; Eymery, R. (CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France). Inst. de Recherche Technologique et de Developpement Industriel (IRDI)). 1987. 8p. (In French). (CONF-870801—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88753918/JAW.

From International conference on nuclear fuel reprocessing and waste management (RECOD '87); Paris, France (24 Aug 1987).

To become independent of the rigid joining between the master and slave arms of a mechanic telemanipulator a new family of manipulators has been developed: the electronic manipulator. The qualification of electronic manipulator MA 23 M is one necessary stage before its utilization in a reprocessing plant. In this paper the author describes the problems met for putting in place the MA 23 M in a hot cell of Marcoule.

39258 (CEA-CONF—9305) Solvent management in a reprocessing plant. Guillaume, B.; Germain, M.; Puyou, M.; Rouyer, H. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Inst. de Recherche Technologique et de Developpement Industriel (IRDI)). 1987. 8p. (In French). (CONF-870801—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88753920/JAW.

From International conference on nuclear fuel reprocessing and waste management (RECOD '87); Paris, France (24 Aug 1987).

Solvent management in large capacity reprocessing plant is studied to limit production of organic wastes. Chemical processing increases life time of solvent. Low pressure distillation allows the recycling of TBP and diluent at a low activity level. Besides heavy degradation products are eliminated. For the safety the flash point of distillated diluent increases slightly. Tests on an industrial scale started in 1985 and since more than 500 cubic meters were treated.

39259 (CEA-CONF—9306) Marcoule pilot work-room: process automatic operation. Mus, G.; Linger, C. (CEA Etablissement de la Vallee du Rhone, 30 - Bagnols-sur-Ceze (France)). 1987. 13p. (FR;EN). (CONF-870801—). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88753921/JAW.

From International conference on nuclear fuel reprocessing and waste management (RECOD '87); Paris, France (24 Aug 1987).

Commissioned in the early 1960s, the Marcoule Pilot Plant has undergone a series of sweeping transformations. The Research and Development resources concerning irradiated fuel processing have been expanded and modified. Its reprocessing capacity has also been raised from 2 to 5 t/year. Simultaneously, the installation control system was completely remodelled. The control consoles, which were previously positioned locally near the different units, have been grouped together in a centralized control room. To do this, the measurement and operating circuits were replaced by new data acquisition and processing systems requiring the use of numerical algorithms. The management and control of certain units, including mechanical fuel preparation, sampling, and sample transport to the laboratories, have been entrusted to programmable automata. Certain unit operations, such as concentration by evaporation, are set up with complete automation. These new arrangements will expand the resources for analysing the operation of the Pilot Plant, while offering a more overall view of the operations. They have been made possible by a major effort in the development of sensors, and represent the indispensable prerequisite for the installation of expert systems.

39260 (CEA-CONF—9307) Marcoule Pilot work-room: overhauling after 20 years of operation and restarting. Farrugia, J.M.; Malterre, G.; Tachon, M.; Polydor, G. (CEA Etablissement de la Vallee du Rhone, 30 - Bagnols-sur-Ceze (France)). 1987. 14p. (In French). (CONF-870801—). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88753922/JAW.

From International conference on nuclear fuel reprocessing and waste management (RECOD '87); Paris, France (24 Aug 1987).

The pilot work-room of Marcoule has for objective to dower the CEA of an experimental test in reprocessing with a sufficient scale to be representative of a factory. In this paper the authors indicate the pilot work-room modifications with a view to adapt it at the reprocessing of oxide fuels strongly irradiated.

39261 (CEA-CONF—9308) Analysis and reprocessing. Buffereau, M. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Inst. de Recherche Technologique et de Developpement Industriel (IRDI)). 1987. 7p. (In French). (CONF-870801—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88753923/JAW.

From International conference on nuclear fuel reprocessing and waste management (RECOD '87); Paris, France (24 Aug 1987).

The aim of a modern laboratory for analysis in reprocessing is to use high sensitivity methods (to limit sample masses, to simplify radiation protection equipment and to decrease effluent production), specific techniques (for accuracy) and automation. Orienta-

tion of developments satisfying to these criteria are presented. Some examples are given.

39262 (CEA-CONF—9325) Actinide extraction by substituted amides or diamides from carboxylic acids. Cuillerdier, C.; Musikas, C.; Morisseau, J.C.; Hoel, P.; Guillaume, B. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. de Genie Radioactif). 1987. 11p. (In French). (CONF-8709301—). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88753932/JAW.

From Summer school on extraction; Toulouse, France (7 Sep 1987).

Amides are studied for use in reprocessing, these solvents can be incinerated and radiolytic degradation have no effect on the process. Main research fields are: 1) Monoamides type RCONR/ sub 2/ allow U (VI) and Pu (IV) extraction like TBP. Ramified R and R' increase the amount of U extracted, the selectivity U/Pu and U + Pu/Fission products. A counter current test gave encouraging results. 2) Diamides for trivalent actinide extraction from radioactive wastes and especially malonamides. Extraction coefficient in function of HNO/sub 3/ concentration are measured for Am (III), En (III), Pu (IV), U (VI) and Zr (IV). Zr should be complexed in aqueous phase to avoid extraction with actinides. Selection of solvent is not yet possible but amides are interesting as alternate extractants.

39263 (CEA-DAS—381) Safety of the new reprocessing plants of La Hague. Devillers, C.; Bastien-Thiry, H.; Dubois, G. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. d'Analyse de Surete). Sep 1987. 8p. (In French). (CONF-870801—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88752402/JAW.

From International conference on nuclear fuel reprocessing and waste management (RECOD '87); Paris, France (24 Aug 1987).

In this document the authors show the main guiding lines on which is based the safety of the new reprocessing plant of La Hague. They are: - the objectives: to limit the impacts on workers and environment - the methods: safety analysis based on the checking and evaluation of significant risks. - the means: to make a safety plant by the use of quality assurance in the conception and in the plant construction.

39264 (CEA-R—5414) Investigation of the extraction kinetics of uranyl nitrate by tributyl phosphate: application of the single drop method in pulsed medium. Dinh, B. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Inst. de Recherche Technologique et de Developpement Industriel (IRDI); Ecole Centrale des Arts et Manufactures, 92 - Chatenay-Malabry (France)). Oct 1987. 164p. (In French). NTIS (US Sales Only), PC A08/MF A01. Order Number DE88752440/JAW.

The investigation by the single drop technique of the uranium extraction kinetics in 3N nitric medium by tributyl phosphate diluted to 30 % in a hydrocarbon, revealed the composite nature of the transfer. The solvation of uranyl nitrate by TBP, assumed to be first order with respect to uranium, is the rate controlling mechanism when the continuous phase is aqueous whereas when the continuous phase is organic, the presence of a diffusional resistance was observed, more or less preponderant, depending on the degree of internal circulation of drops. Analysis in pulsed medium confirmed these observations and showed that the transfer kinetics is only accelerated by pulsation when the continuous phase is organic, for drops around 3mm in diameter only. The results of the analysis of the transfer mechanism serves to explain the influence of plate wettability by the dispersed phase on the transfer performance, observed during the extraction of uranium in a pulsed column.

39265 (CNIC—00051) Dynamic characteristics of the mixer-settlers under PRBS disturbing signal. Wan Hongjun; Liu Qiusheng; Qian Yudi. (China Nuclear Information Centre, Beijing, BJ). 1987. 28p. (In Chinese). (BINE—0001). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702633/JAW.

The dynamical characteristics for the designing of the control system for 1A mixer-settler of Purex process are studied. The dynamic theoretical model of the extractor-cascades given in this paper can predict the dynamic response of the components in two phases. On the basis of this model, adding PRBS disturbing function to the input aqueous and organic flows, dynamic mathematic simulation can be carried out. Provided that the disturbing signal condition maintains the same, the error margin between experimental and calculating results is about 10% and 15% corresponding to the organic and aqueous phases. The dynamic test was also carried out in a pilot plant air pulse mixer-settler. Technological system of the experiment was UO/sub 2/(NO/sub 3/)/sub 2/ + HNO/sub 3/ + H/sub 2/O/TBP30% + OK. PRBS signal produced by computer was added to input parameters. Out-put parameters were measured continuously via on-line instruments.

39266 (CONF-880601—11) The ^{252}Cf noise analysis method for in-plant criticality safety. Mihalczo, J.T. (Oak Ridge National Lab., TN (USA)). 1988. Contract AC05-84OR21400. 7p. NTIS, PC A02/MF A01;1; GPO Dep. Order Number DE88005186/JAW.

From American Nuclear Society annual meeting; San Diego, CA, USA (12 Jun 1988).

The ^{252}Cf-source-driven neutron noise analysis method for obtaining the subcritical neutron multiplication factor k/sub eff/ of a configuration of fissile material from cross-power spectral densities (CPSDs) was developed to avoid difficulties inherent in other subcriticality measurement methods. These difficulties include a need for a calibration at a known reactivity condition near delayed critical and a dependence on detection efficiency that may be more dependent on the configuration of fissile material than k/sub eff/. This method has promise for in-plant applications as has been demonstrated in {approximately}20 experiments with a wide variety of fissile material configurations.

39267 (EUR—10923) Determination of composition and radioactivity of hulls from industrial processing of light water reactor fuels. COQUENSTOCK program. Gue, J.P.; Isaac, M.; Masson, M. (Commission of the European Communities, Luxembourg). 1986. 278p. (In French). NTIS (US Sales Only), PC A13/MF A01. Order Number DE88752439/JAW.

The characterization programm for OBRIGHEIM and STADE PWR hulls sampled at la Hague was conducted in the CEA hot cells (COQUENSTOCK program operating on whole assembly hulls). After describing the appearance of these hulls, recovered on the industrial scale, the results of the different radiochemical characterization operations are reviewed: measurements of neutron emission and correlation with the residual fuel associated with the hulls; spectrometry measurements by gamma scanning on containers of multiliters capacity; after dissolution of several samples, determination of contents of uranium and transuranic elements and α β γ and strontium activities; determination of the retention of tritium and other gaseous fission products occluded in the zircaloy clads. The alpha contamination of these hulls proved to be rather high, but a large part (90 to 95%) is labile and removed with cold 3N nitric acid. Contamination by fission products such as: Cs 137 - Ce 144 - Eu 154 remains high and little affected by nitric acid rinsing.

39268 (EUR—11120) Studies on fire and explosion hazards of Zircaloy fines. Andriessen, H.; Kroebel, R.; Beznai, T.; Wurtz, R.; Hattwig, M.; Hensel, W.; Osswald, R. (Commission of the European Communities, Luxembourg). 1987. 80p. (In German). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88753954/JAW.

To promote the safe handling of the Zry-fines arising in a reprocessing plant, an experimental program was conducted under which the fire and explosion hazards were assessed. In order to evaluate the effect of irradiation on the ignition and explosion properties, irradiated and unirradiated Zry-fines, generated with the same tool, were investigated and compared which each other. Irradiated Zry-fines exhibit a higher fire and explosion hazard than non-irradiated fines passing the same sieve. These differences are caused mainly by the irradiation induced embrittlement and hardening of the Zry-hulls. On account of these different physical properties the generated fines have got a finer grain size due to a more spherical shape resulting in a higher bulk density and a lower mean value. These secondary irradiation effects seem to determine the

lower minimum ignition temperatures and the higher values for the maximum explosion pressure and rate of pressure rise.

39269 (GRS—67) Safety aspects of nuclear fuel reprocessing. Huber, J.; Mester, W.; Thomas, W. (Gesellschaft fuer Reaktorsicherheit m.b.H. (GRS), Koeln (Germany, F.R.)). Oct 1987. 141p. (In German). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88754009/JAW.

Today there are about ten plants in operation for reprocessing of nuclear fuel in the western countries. Some further plants are out of operation, and others are in construction or planned. In the FRG the WAK works since 1971. On and after the year 1997 the German reprocessing plant proposed at site Wackersdorf with an annual average capacity of 350 tons should be available. This report describes not only the technical process for reprocessing nuclear fuels but deals especially with operational experiences. Most emphasis is put on safety related requirements. So legal requirements, safety goals, and preventing measures, e.g., are dealt with under technical as well as organizational aspects. Radioactive waste management and transports of radioactive material is included. As a result of risk related investigations one may assume, that the total risk of a reprocessing plant only amounts to a small part of the radiation risk from nature and civilization.

39270 (INIS-mf—11112) Study of stripping crystallization processes of AUC with ammonium carbonate. Chegrouche, S. (Haut Commissariat a la Recherche, Algiers (Algeria). Centre d'Etudes Nucleaires et Solaires). Sep 1987. 155p. (In French). NTIS (US Sales Only), PC A08/MF A01. Order Number DE88701628/JAW.

This study is concerned with direct crystallization of ammonium uranyl carbonate (AUC) from a uranium loaded organic phase (30% TBP in kerosene), with ammonium carbonate (NH/sub 4/)/sub 2/CO/sub 3/. The effects of operating conditions ((NH/sub 4/)/sub 2/CO/sub 3/ concentration, flow-ratio, residence time, temperature) on the physical properties of AUC crystals (particle size distribution, specific surface, density...) are reported. All products were identified (both by chemical analysis, X-Ray diffraction) as being ammonium uranyl carbonate crystals (AUC). The results show that a high phase ratio and (NH/sub 4/)/sub 2/CO/sub 3/ concentration favor the formation of fine AUC grains and aggregates. This is due mainly to the high concentration of NH/sup +//sub 4/ in the system which leads to a high solution supersaturation and consequently to a rapid formation rate of crystal (germination). The reverse phenomenon is observed at low phase ratio and (NH/sub 4/)/sub 2/CO/sub 3/ concentration, where germination and crystal growth are slow and the product is mainly monocrystal. In the intermediate range, a mixture of polycrystal and aggregates is obtained. Residence and temperature are also shown to have an effect on the processes (the effect of time being more important than temperature). In the course of this study a bench-scale stripper-crystallizer was developped and operated successfully. (author). tables, graphs.

39271 (INIS-mf—11776) Need for and the safety of the German spent fuel reprocessing plant at Wackersdorf. (Deutsche Gesellschaft fuer Wiederaufarbeitung von Kernbrennstoffen m.b.H. (DWK), Hannover (Germany, F.R.)). Feb 1987. 72p. (In German). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88754173/JAW.

The reprocessing of spent fuel elements from LWR-type reactors is a technically mature and marketable process. The German spent fuel reprocessing plant under construction at Wackersdorf is expected to bring in foreign exchange savings in the Federal household amounting to several hundred millions of DM a year, thus contributing in the long run to the energy political independence of the F.R.G. At the same time, reduced exploitation of resources for uranium production will cut back the effects on the natural environment. Reprocessing technology last not least meets an obligation set by law, namely to recycle the radioactive wastes from nuclear fuel utilisation in a way avoiding harm to the environment. The alternative waste management option, i.e. direct ultimate disposal of spent fuels, does not offer significant advantages over the reprocessing concept in terms of safety, environmental protection, or economics. (orig./HSCH).

39272 (JAERI-M—88-026) Development of partitioning method. Method of precipitating transuranium elements with oxalic acid. Kobayashi, Tsutomu; Morita, Yasuji; Kubota, Masumitsu. (Japan Atomic Energy Research Inst., Tokyo). Feb 1988. 21p. (In Japanese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88754113/JAW.

Present study was carried out to develop a method of precipitating transuranium elements as oxalate from high-level liquid waste (HLW). The main results obtained from the precipitation experiments with several simulated HLW are as follows. 1) Transuranium elements of trivalent state, such as americium and curium, can be precipitated quantitatively by adding particulate oxalic acid to about 2M nitric acid solution. 2) Neptunium (V), which is stable in HLW, is one of the most difficult transuranium elements to precipitate. It's precipitation rate is affected by iron, plainum group elements, etc.. 3) All transuranium elements can be precipitated almost quantitatively by adding oxalic acid to the solution containing ascorbic acid.

39273 Aerosols released in accidents in reprocessing plants. Ballinger, M.Y.; Owczarski, P.C.; Hashimoto, K.; Nishio, G.; Jordan, S.; Lindner, W. (Battelle Pacific Northwest Labs., P.O. Box 999, Richland, WA (US)). *Nuclear Technology;* **81**: No. 2, 278-292(May 1987).

For analyzing the thermodynamic and radiological consequences of solvent fire accidents in reprocessing plants, intensive investigations on burning contaminated condensible liquids were performed at Kernforschungszentrum Karlsruhe (KfK), Pacific Northwest Laboratory (PNL), and Japan Atomic Energy Research Institute (JAERI). In small- and large-scale tests, KfK studied the behavior of kerosene, tributyl phosphate, HNO_3 mixture fires in open air and closed containments. The particle release from uranium-contaminated pool fires was investigated. Different filter devices were tested. For analyzing fires, PNL has developed the FIRIN computer code and has generated small-scale fire data in support of that code. The results of the experiments in which contaminated combustible liquids were burned demonstrate the use of the FIRIN code in simulating a solvent fire in a nuclear reprocessing plant. To demonstrate the safety evaluation of a postulated solvent fire in an extraction process of a reprocessing pant, JAERI conducted large-scale fire tests. Behavior of solvent fires in a cell and the integrity of high-efficiency particulate air (HEPA) filters due to smoke plugging were investigated. To evaluate confinement of radioactive materials released from the solvent fire, the ventilation systems with HEPA filters were tested under postulated fire conditions.

0509 Transport And Storage

REFER ALSO TO CITATION(S) 39244, 39266

39274 (CEA-DAS—382) Safety of handling spent fuels in pool D of La Hague: conception of operating system. Guczenec, J.; Bastien-Thiry, H.; Chaumette, A.M. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. d'Analyse de Surete). Sep 1987. 8p. (In French). (CONF-870801—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88752401/JAW.

From International conference on nuclear fuel reprocessing and waste management (RECOD '87); Paris, France (24 Aug 1987).

After a presentation of handling operations in the pool D of the reprocessing plant UP3. A (cooling pond for spent fuels before reprocessing), the authors indicate the safety approach used. The influences of this approach on the conception of the operating systems are indicated.

39275 (K/QT—166) Investigation of the thermal behavior of 2-1/2 ton cylinder protective overpack. Park, S.H. (Oak Ridge Gaseous Diffusion Plant, TN (USA)). 1988. Contract AC05-84OT21400. 14p. (CONF-880558—9-Vugraphs). NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88010427/JAW.

From Uranium hexafluoride--safe handling, processing, and transporting conference; Oak Ridge, TN, USA (24 May 1988).

UF_6 cylinders containing reactor grade enriched uranium are transported in protective overpacks. Recently, the design of the 2-

1/2 ton UF_6 cylinder overpack was modified to insure the safety of the cylinder inside the overpack. Modifications include a continuous stainless liner from the outer surface to the inner surface of the overpack and step joints between the upper and lower halves of the overpack. The effects of a continuous stainless steel liner and moisture in the insulation layer of a UF_6 cylinder protective overpack were investigated with a numerical code. Results were compared with limited available field data. The purpose of comparing the numerical results with field data is to insure the validity of the numerical analysis and the physical properties used in the analysis. The study indicates that the continuous stainless steel liner did not influence the heat transfer rate much from the outer surface of the overpack to the 30B cylinder inside. The effect of step joints was not modeled due to the difficulty of quantifying the leakage rate through the gap. With a continuous stainless steel liner from the outside of the overpack to the inside, the overpack satisfies the thermal design criteria of protecting the cylinder inside for a minimum of 30 minutes when the overpack is exposed to a fire. The effect of moisture inside the insulation layer in the overpack is to reduce the energy to the cylinder with its high thermal capacity. The high pressure steam generated from the moisture will be relieved externally through the vent holes on the outer surface of the overpack. Although these holes are sealed after the overpack is dried, the plug sealing the holes will melt when the overpack is exposed to a fire. 3 refs., 8 figs.

39276 **(KFK—4344) Testing of the permissible inventories in radioactive waste packages.** Stegmaier, W. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Hauptabteilung Dekontaminationsbetriebe). Mar 1987. 53p. (In German). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88754182/JAW.

The inventories of radionuclides in waste packages which are to be stored in repositories are determined in the Waste Acceptance Requirements of the repository and in the Act on Transport of Dangerous Goods. In this report limiting values of relevant radionuclides are given in such a way that it is possible to use them in a standardized manner. The limiting values apply to single radionuclides, for handling mixtures of nuclides it is necessary to use the sum formula. The minimized number of waste packages which must be produced from a given quantity of raw waste and an inventory of radionuclides keeping all parameters can be calculated with the help of the shown calculating sheet.

0510 Marketing, Economics, And By-products

REFER ALSO TO CITATION(S) 39320, 39379

0520 Waste Management

REFER ALSO TO CITATION(S) 39272, 39276, 39420, 39783, 39937, 39964, 39965, 39966, 40304, 40361, 40428, 40430, 40478, 40491, 40499, 40500, 40577, 40611, 41323, 41615

39277 **(AD-A—190504/1/XAB) Studies of the geochemical stability of a salt-saturated expansive grout. Final report, October 1986-June 1987.** Wakeley, L.D.; Poole, T.S. (Army Engineer Waterways Experiment Station, Vicksburg, MS (USA). Structures Lab.). Sep 1987. 80p. (WES/MP/SL—87-10). NTIS, PC A05/MF A01.

Availability: Document partially illegible.

Laboratory experiments were conducted on several aspects of durability of grout in the special environment of a repository for radioactive wastes in bedded halite rock. Variables tested include solubility of grout components, phase changes, and mobility of chloride relative to interfaces with rock and brine or freshwater. The grout tested had large percentages of both chloride and sulfate. Chloride was more mobile when the grout was exposed to freshwater, and sulfate when exposed to brine. Removal of chloride from the grout accompanied loss of chloroaluminate phase, rather than simply dissolution of sodium chloride. However, chloride gradients were not apparently related to an interface between grout and halite rock. With extended exposure to brine or freshwater, calcium represented the largest fraction of mass loss, as determined by analyses of exposure solutions. Sulfate loss was the second largest. This effect increased with time and temperature of exposure. Volume increase of test specimens indicated continued or renewed expansion, even after the initial curing or storage period (28 days or 9 months), when the grout was exposed to water or brine. The combination of volume increase with mass loss suggests a density decrease, but this did not cause loss of physical integrity of specimens.

39278 **(AD-A—191174/2/XAB) Development and implementation of instrumentation for WIPP (Waste Isolation Pilot Plant) Test Series A of the small-scale seal performance tests. Final report.** Ainsworth, D.L. (Army Engineer Waterways Experiment Station, Vicksburg, MS (USA). Structures Lab.). Jan 1988. 64p. (WES/TR/SL—88-4). NTIS, PC A04/MF A01.

The Waste Isolation Pilot Plant (WIPP) facility is a research and development facility being developed by the US Department of Energy (DOE) near Carlsbad, New Mexico for the purpose of demonstrating the safe disposal of radioactive waste accumulated from the United States defense programs. The WIPP facility is located in a bedded-salt deposit 2150 ft (656m) below the ground surface. Sandia National Laboratories (SNL) is conducting a repository sealing Research and Development Program at the WIPP facility. The work discussed in this report was in support of Test Series A of the Small-Scale Seal Performance Tests being conducted at the WIPP facility for SNL. The Small-Scale Seal Performance Tests consist of a series of in-situ experiments designed to evaluate the performance of various candidate seal materials emplaced in boreholes in the host rock. At the request of SNL, the Concrete Technology Division (CTD) of Waterways Experiment Station (WES) developed an instrumentation program of sufficient magnitude to support the thermal and structural studies of the concrete seal to rock system being conducted for SNL by others at CTD WES and SNL. The test program consisted of two phases: a laboratory mockup of the Test Series A configuration, conducted at WES; and a Test Series A field experiment, conducted underground at the WIPP facility.

39279 **(AECL—8398) Canadian fuel waste management program. 1984 annual report.** McConnell, D.B. (ed.). (Atomic Energy of Canada Ltd., Pinawa, Manitoba. Whiteshell Nuclear Research Establishment). Apr 1986. 269p. NTIS (US Sales Only), PC A12/MF A01. Order Number DE88703084/JAW.

French version included as AECL--8398F.

This report is the sixth in the series of annual reports on the research and development program for the safe management and disposal of Canada's nuclear fuel waste. The report summarizes progress in 1984 for the following activities: storage and transportation of used fuel, immobilization of nuclear fuel waste, geotechnical research, environmental research, and environmental and safety assessment. 186 refs.

39280 **(AERE-G—3903) Electrical processes for liquid waste treatment.** Turner, A.D.; Bridger, N.J.; Junkison, A.R.; Pottinger, J.S. (UKAEA Harwell Lab. Materials Development Div.; Department of the Environment, London (UK)). Aug 1987. 103p. (DOE-RW—87.126). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88753980/JAW.

This report describes the development of electrical techniques for the treatment of liquid waste streams. Part I is concerned with solid/liquid separation and the demonstration of the electrokinetic thickening of flocs at inorganic membranes suitable for intermediate-level wastes and electrochemical cleaning of stainless steel microfilters and graphite ultrafilters. Part II describes work on the development of electrochemical ion exchange, particularly the use of inorganic absorption media and polarity reversal to enhance system selectivity. Work on the adsorption and desorption of plutonium in acid nitrate solution at various electrode materials is also included.

39281 **(AERE-G—4532) Development of remote electrochemical decontamination for hot cell applications. Annual progress report 1987.** Turner, A.D.; Pottinger, J.S.; Lain, M.J.; Dawson, R.K.; Neville, M.D.; Junkison, A.R. (UKAEA Harwell Lab. Materials Development Div.). Jan 1988. 6p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88754096/JAW.

The paper concerns the development and evaluation of remote electrochemical decontamination systems for metal surfaces, in connection with the decommissioning of nuclear installations. Two types of technique based on the electrochemical dissolution of thin surface layers of the substrate were investigated: immersion of small items in tanks for electroetching and in situ electropolishing. A description is given of the work programme, the progress of work and the results obtained. (U.K.).

39282 **(AERE-R—12306) Preliminary neutron scattering studies of porosity of clay.** Allen, A.J.; Bourke, M.A.; Bourke, P.J.; Jefferies, N.L. (UKAEA Harwell Lab. Chemistry Div.; United Kingdom Nirex, Ltd.). Dec 1987. 25p. (NSS/R—106). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88753982/JAW.

Attempts to measure diffusively accessible porosity in Oxford clay using iodide ions as the diffusing solute in pore water gave values of about 10% in hundred hour tests. There is however some uncertainty about these results both because the times may not have been long enough for diffusion into all the pores and because the iodide may have been partly sorbed by the clay. A repeat measurement, also for 100 hours, using D/sub 2/O as the solute gave a porosity of 9%. These values are low compared with the 25 to 50% values obtained by weighing and drying, mercury porosimetry and gas measurements. To investigate this discrepancy, scanning electron microscopy was used to obtain information about the sizes and shapes of pores and preliminary small angle neutron scattering measurements were made before and after D/sub 2/O transfer through the clay to determine the sizes and volumes of all pores and also of those accessible to D/sub 2/O. It is thought that these techniques will be adequately able to characterise the porosity of clay which is required to evaluate it as a barrier to radionuclide movement from buried waste.

39283 **(AERE-R—12370) Data for the sorption of actinides on candidate materials for use in repositories.** Morgan, R.D.; Pryke, D.C.; Rees, J.H. (UKAEA Harwell Lab. Chemistry Div.; Department of the Environment, London (UK)). Feb 1988. 62p. (ILWRP—86-P11A; DOE-RW—87.094). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88753983/JAW.

The sorptive behaviour of the actinides uranium, neptunium, plutonium and americium has been investigated under air-saturated conditions on a number of candidate near-field materials by batch sorption experiments. Distribution ratios were measured with respect to initial actinide concentration, the solid:liquid ratio and contact time. Desorption experiments were carried out to help elucidate the mechanism of sorption. The fit of the data to the Freundlich isotherm was assessed. This work contains the data obtained in the investigation.

39284 **(BMI/OCRD—29) Annotated bibliography of selected reports relating to the isolation of nuclear waste in crystalline rock.** (Battelle Memorial Inst., Columbus, OH (USA). Office of Crystalline Repository Development). Jun 1988. Contract AC02-83CH10139. 73p. NTIS, PC A04/MF A01; GPO Dep. Order Number DE88012715/JAW.

BMI/OCRD-29 is an annotated bibliography of published reports that have been produced for the US Department of Energy Crystalline Repository Project Office or the Swedish-American Cooperative Program on Radioactive Waste Storage in Mined Caverns. This document consists of a main report listing of citations and abstracts and a topical index.

39285 **(BMI/ONWI—673) Preliminary review of retrieval issues for a high-level nuclear waste repository in salt: Technical report.** Smith, L.A. (Battelle Memorial Inst., Hereford, TX (USA). Office of Nuclear Waste Isolation). Nov 1987. Contract AC02-83CH10140;AC02-87CH10290. 59p. NTIS, PC A04/MF A01. Order Number DE88008460/JAW.

This document highlights topics related to the retrieval of nuclear waste from a mined geologic repository in salt. Retrieval is an event that, although it is not expected, must be planned for. Major programmatic documents and Federal regulations require that the waste should be retrievable. It is therefore an important design consideration that the option exists to retrieve waste in the unlikely event retrieval is needed. There are several broad issues involved in a repository in salt that have significant implications to retrieval systems. Among these are high temperatures that can affect mining equipment operation and personnel safety; the viscoplastic behavior of salt that results in room closure and increased potential for unstable openings; and nuclear issues such as radiation and contamination, criticality, and acountability and safeguards. 26 refs., 2 figs., 1 tab.

39286 **(BMI/ONWI/C—1) Assessment of the character and extent of mechanical disturbance for underground openings in salt.** (Golder Associates, Inc., Redmond, WA (USA)). Jul 1987. Contract AC02-87CH10290. 135p. H;1. Order Number TI88012840/JAW.

This report provides an assessment of the nature and extent of the mechanically disturbed zone surrounding excavations in salt, based on information currently available in the literature (September 1985). Three zones have been defined which make up the overall zone of mechanical disturbance: zone 1—a zone of fracturing; zone 2—a zone of significant straining; and zone 3—a zone of influence. The limits of these zones have been defined based on domal salt and bedded salt and potash case studies and are presented as a first step in quantifying the limits of mechanical disturbance around underground openings in salt. It is emphasized that ultimate proof of the nature and extent of mechanical disturbance around openings in salt and quantification of the significance of mechanical disturbance to salt repository performance will be established by detailed analysis of the data collected during field testing at the actual repository horizon. 111 refs., 4 figs., 5 tabs.

39287 **(BMI/ONWI/C—2) Basic repository source term and data sheet report: Deaf Smith County.** (Stearns Catalytic Corp., Denver, CO (USA)). 1987. Contract AC02-87CH10290. 74p. H. Order Number TI88012835/JAW.

This report is one of a series describing studies undertaken in support of the US Department of Energy Civilian Radioactive Waste Management (CRWM) Program. This study contains the derivation of values for environmental source terms and resources consumed for a CRWM repository. Estimates include heavy construction equipment; support equipment; shaft-sinking equipment; transportation equipment; and consumption of fuel, water, electricity, and natural gas. Data are presented for construction and operation at an assumed site in Deaf Smith County, Texas. 2 refs., 6 tabs.

39288 **(BMI/ONWI/C—5) Rod consolidation study: Final report.** (Battelle Memorial Inst., Columbus, OH (USA). Office of Nuclear Waste Isolation; Fluor Technology, Inc., Irvine, CA (USA)). Mar 1988. Contract AC02-87CH10290;AC02-83WM46656. 668p. H. Order Number TI88012843/JAW.

This report documents the investigations and results of the rod consolidation study. This study was conducted by Fluor Technology, Inc., the Architect/Engineer (A/E) for the Salt Repository Project Office (SPRO). This study considered the issue of spent fuel consolidation at the salt repository. A repository design that incorporated consolidation by spent fuel disassembly was compared with a design that featured disposal of intact spent fuel. Current salt repository conceptual designs were used as a basis for the two designs. The two designs were compared in a quantitative and qualitative evaluation. The evaluation considered cost, schedule, safety, licensing, and other factors. As a result, a final recommendation is

made of the design that is preferred by the salt repository A/E. This study also provided the repository data for integrated systems using a Monitored Retrievable Storage (MRS). No specific conclusions were drawn regarding the preferability of an MRS from the repository standpoint. However, the data generated will support decisions on this topic in the future. 14 refs., 41 figs., 43 tabs.

39289 (BMI/ONWI/C—8) Available thermochemical data and data requirements for a salt repository for thorium, plutonium, americium, and curium: Salt repository project. Schramke, J.A.; Mattigod, S.V.; Rai, D. (Pacific Northwest Lab., Richland, WA (USA)). 30 Jun 1987. Contract AC02-87CH10290;AC06-76RL01830. 203p. H. Order Number TI88012833/JAW.

Geochemical reactions are typically defined in terms of a mass-action law that contains a thermochemical constant, such as an equilibrium constant or the related free energy of reaction at standard conditions. A well-defined set of thermochemical data is thus necessary for accurate prediction of the geochemical behavior of the radionuclides in the repository environment. Therefore, the available thermochemical data for the radionuclides thorium, plutonium, americium, and curium were compiled and reviewed. The scheme used in the review of the available literature is illustrated. The principal components of the review are selecting relevent oxidation states for the radionuclides; preparing a comprehensive tabulation of the data; selecting the solids and aqueous species likely to be important in the repository environment, based on solubility and speciation diagrams for each oxidation state under the expected repository conditions; evaluating the sources of the tabulated data, and generating recommendations for future research priorities for the Salt Repository Project. 263 refs., 15 figs., 72 tabs.

39290 (BMI/ONWI/C—15-Rev.1) Evaluation of geophysical techniques for identifying fractures in program wells in Deaf Smith County, Texas: Revision 1, Topical report. Gillespie, R.P.; Siminitz, P.C. (Battelle Memorial Inst., Columbus, OH (USA). Office of Nuclear Waste Isolation; Stone and Webster Engineering Corp., Boston, MA (USA)). Aug 1987. Contract AC02-87CH10290;AC02-83CH10140;AC02-87CH10285. 30p. (BMI/ONWI—681-Rev.1; ONWI/Sub—87/E512-05000-T43-Rev.1). H; GPO Dep. Order Number DE88012358/JAW.

Quantitative information about the presence and orientation of fractures is essential for the understanding of the geomechanical and geohydrological behavior of rocks. This report evaluates various borehole geophysical techniques for characterizing fractures in three Civilian Radioactive Waste Management (CRWM) Program test wells in the Palo Duro Basin in Deaf Smith County, Texas. Emphasis has been placed on the Schlumberger Fracture Identification Log (FIL) which detects vertical fractures and provides data for calculation of orientation. Depths of FIL anomalies were compared to available core. It was found that the application of FIL results to characterize fracture frequency or orientation is inappropriate at this time. The uncertainties associated with the FIL information render the information unreliable. No geophysical logging tool appears to unequivocally determine the location and orientation of fractures in a borehole. Geologic mapping of the exploratory shafts will ultimately provide the best data on fracture frequency and orientation at the proposed repository site. 22 refs., 6 figs., 3 tabs.

39291 (BMI/ONWI/C—17) Final draft position on geotechnical instrumentation in a salt repository environment: Requirements, performance, recommendations, and development needs. (Battelle Memorial Inst., Columbus, OH (USA). Office of Nuclear Waste Isolation; Golder Associates, Inc., Redmond, WA (USA)). Jul 1987. Contract AC02-87CH10290;AC02-83CH10140. 336p. H. Order Number TI88012384/JAW.

This report presents the results of a study of the present status of geotechnical instrumentation with respect to potential use in an underground test facility at a candidate nuclear waste repository site in salt. Programmatic factors that have a general impact on the success of underground instrumentation are discussed. Performance requirements relating to accuracy, temperature range, longevity, and capability for automation are established on the basis of criteria proposed for other rock types, perceived needs of the Site Characterization Program, and the authors' experience and judgment. Test site conditions are discussed including underground logistics, corrosion, and other factors that affect instrument reliability. The status of existing instrumentation for measuring deformation, stress, temperature, fluid pressure, acoustic emission, and other less critical parameters is presented. For each instrument not presently capable of satisfying its associated performance requirements, specific development needs and possible approaches are identified, and necessary testing is describe to a conceptual level of detail. A brief discussion of instrument considerations relating to automatic data acquisition is also included. The position of instrument development as a key activity on the critical path under current schedules for the Site Characterization Program is discussed. Annotated references and reports on site visits and meetings used as the data base in evaluating present instrument status are appended to this report. 110 refs., 14 figs., 26 tabs.

39292 (BMI/ONWI/C—18) Interim data base for abnormal and miscellaneous wastes: Engineering study report. (Fluor Technology, Inc., Irvine, CA (USA)). May 1987. Contract AC02-83WM46656;AC02-87CH10290. 40p. H. Order Number TI88012349/JAW.

The Nuclear Waste Repository in Salt will receive, process, and emplace radioactive wastes requiring disposal under 10CFR60. These wastes include irradiated reactor fuel, solidified waste forms resulting from specified irradiated reactor fuel reprocessing, and other commission specified highly radioactive materials requiring permanent isolation. Appendix E of 10CFR961 Subpart B—"Standard Contract for Disposal of Spent Nuclear Fuel and/or High-Level Radioactive Wastes" identifies standard and nonstandard fuels and high-level radioactive wastes which may be included as part of spent nuclear fuel delivered for disposal. Certain nonfuels reactor components are included. Abnormal and miscellaneous wastes presented in this report exclude standard LWR spent fuel or HLW resulting from reprocessing. Such abnormal and miscellaneous wastes include nonfuel components of PWR and BWR fuel assemblies, the General Atomic High Temperature Gas Cooled Reactor fuel elements, reactor decommissioning wastes, TMI-2 reactor core materials, fuel assembly hardware and other stabilized wastes from the salt repository operations, and cesium and strontium radioisotopes solidified and encapsulated from defense wastes. The study report documents the work accomplished during fiscal year 1984. Program realignment assigns responsibility for waste identification to the Department of Energy Headquarters support contractor. 10 refs., 6 figs., 3 tabs.

39293 (BMI/ONWI/C—23) Salt Repository Project site study plan for land use: Revision 1. (USDOE Salt Repository Project Office, Hereford, TX; Stone and Webster Engineering Corp., Boston, MA (USA)). Dec 1987. Contract AC02-87CH10290. 57p. OSTI, PO Bx 62, Oak Ridge, TN 37831- Available from OSTI.. Order Number TI88012350/JAW.

The Site Study Plan for Land Use describes a field program consisting of characterization of the site, seismic survey rights-of-way, vicinity, region, and future land use. Aerial photography will be used to characterize the site, the seismic rows, and the vicinity. The resulting land-use maps and overlays will then be verified in the field. Interviews with farm managers and local experts will provide additional information. A Geographic Information System (GIS) and satellite imagery will be used to characterize the region, and provide information to assist with the future land use study. The site study plan describes the study design and rationale, the field data collection procedures and equipment, the data analysis methods and application of results, the data management strategy, the schedule of field activities, the personnel requirements and management of the study, and the study's quality assurance program. The directives and requirements that drive these studies are derived from the Salt Repository Project Requirements Document. 37 refs., 5 figs., 3 tabs.

39294 **(BMI/ONWI/C—29) Report of the panel on evaluation of ground-water flow in fractures at the Palo Duro Basin, Texas: Unanalyzed data: Technical report.** (Battelle Memorial Inst., Columbus, OH (USA). Office of Nuclear Waste Isolation). Jan 1988. Contract AC02-87CH10290. 385p. (BMI/SRP—5048). H. Order Number TI88012846/JAW.

A peer review group of hydrologists assessed the importance and availability of data on fracture-controlled ground-water flow at the Palo Duro Basin sites in the Permian Basin in Texas. After hearing presentations by US Department of Energy staff and consultants, and reviewing existing literature, they formed a conceptual model of basin flow that is downward across the salt facies and downdip in permeable formation in the lower hydrostratigraphic unit. Flow volumes and rates are very low. The panel examined several possible fracture-flow scenarios and concluded that flow within the salt section is probably porous-media-dominated with some fracture-flow influence in brittle zones. Fracture flow in the salt itself is rejected as a possibility based on current evidence. However, the panel recommended that fracture flow in the system should be included as a low-probability variable in any hydrogeologic modeling. They also concluded that many more data on lineament features and subsurface structures are needed to accurately characterize the system and to refine the modeling effort. 9 refs., 2 figs.

39295 **(BMI/ONWI/C—39) Solubility issues related to the performance of a high-level nuclear waste repository in bedded salt: A survey of data needs for solubilities and aqueous species of technetium, radium, and iodine: Nuclear and Chemical Waste Program.** O'Kelley, G.D. (Battelle Memorial Inst., Columbus, OH (USA). Office of Nuclear Waste Isolation; Oak Ridge National Lab., TN (USA)). Jul 1987. Contract AC02-87CH10290;AC05-84OR21400. 100p. (ORNL/TM—10510). H. Order Number TI88011644/JAW.

A survey of the literature on the solubility and aqueous species of technetium, radium, and iodine was conducted, with special emphasis on salt repository brines. The elements reviewed here were three of a total of seventeen elements reviewed by participating laboratories. Comprehensive tables of solid compounds and aqueous species for each elements were screened according to a uniform set of procedures. Technetium solid compounds selected for further solubility studies in repository brines were TcO_2{center←dot}nH_2O, TcS_2, and Tc_2S_7. Aqueous species of interest were those associated with solubility measurements and complexing ligands such as phosphate and carbonate species. The least soluble compounds of radium are expected to be $RaSO_4$ and $Ra_3(PO_4)_2$, although thermodynamic estimates predict that RaF_2 and $RaCO_3$ may also be of some concern under particular circumstances. In cases where concentrations are too low to precipitate a pure radium phase, it appears probable that the concentration of Ra^{2+} in a brine may be limited by formation of solid solutions with insoluble compounds of other Group II A elements. The aqueous species of most concern are those associated with the least soluble solid compounds of radium, e.g., phosphate, sulfate, fluoride, and carbonate. No solid species of iodine were identified as important in repository brines. The species of iodine of major interest are those involved in the hydrolysis of I_2 to I/sup {minus}/ and IO_3/sup {minus}/, including trihalide ions and HOI. 40 refs., 5 figs., 21 tabs.

39296 **(BMI/ONWI/C—40) Sea materials experimental plans.** (Battelle Memorial Inst., Columbus, OH (USA). Office of Nuclear Waste Isolation; Science Applications, Inc., San Francisco, CA (USA)). Jul 1987. Contract AC02-87CH10290. 429p. OSTI, PO Bx 62, Oak Ridge, TN 37831-Available from OSTI.. Order Number TI88011645/JAW.

This Seal Materials Performance Test Plan describes the plan for testing materials that will be used to seal a high-level nuclear waste repository in salt at a proposed site in Deaf Smith County, Texas. The need for sealing and backfilling the repository and the use of various sealing materials are described. The seal materials include mined salt backfills, cementitious bulkheads and plugs, and earthen backfills. The laboratory testing program for characterizing the behavior and performance of these materials is described. This report includes plans for screening materials, evaluating candidate materials to be tested, and testing a representative set of materials.

39297 **(BMI/ONWI/C—45) Basic repository source term and data sheet report: Davis Canyon.** (Battelle Memorial Inst., Columbus, OH (USA). Office of Nuclear Waste Isolation; Stearns Catalytic Corp., Denver, CO (USA)). 1988. Contract AC02-87CH10290. 78p. H. Order Number TI88011654/JAW.

This report is one of series describing studies undertaken in support of the US Department of Energy Civilian Radioactive Waste Management (CRWM) Program. This study contains the derivation of values for environmental source terms and resources consumed for a CRWM repository. Estimates include heavy construction equipment; support equipment; shaft-sinking equipment; transportation equipment; and consumption of fuel, water electricity, and natural gas. Data are presented for construction and operation at an assumed site in Davis Canyon, Utah. 6 tabs.

39298 **(BMI/ONWI/C—46) Test plans for the measurements of solubilities and stabilities of nickel(II) and zirconium(IV) containing species in brine solutions.** Rizkalla, E.N.; Choppin, G.R. (Battelle Memorial Inst., Columbus, OH (USA). Office of Nuclear Waste Isolation; Florida State Univ., Tallahassee (USA). Dept. of Chemistry). Mar 1988. Contract AC02-87CH10290. 30p. OSTI, PO Bx 62, Oak Ridge, TN 37831- Available from OSTI. Order Number TI88011653/JAW.

The general objectives of this proposal is to identify and obtain appropriate thermodynamic data on the solubilities of nickel salts and the stabilities of soluble nickel complexes which are likely to exist in the salt repository. The starting test materials would be the appropriate solid phase prepared, analyzed and characterized according to standard procedures. The crystallinity of these compounds would be checked prior and after the test measurements using x-ray technique. The aqueous phase would cover a range of ionic strengths between 0.0–5.3 M (NaCl) and the limiting solubilities would be checked as a function of time at controlled conditions of pH, Eh and temperatures. 31 refs., 4 tabs.

39299 **(BMI/ONWI/C—51) Salt Repository Project site study plan for meteorology/air quality: Revision 1.** (USDOE Salt Repository Project Office, Hereford, TX; Stone and Webster Engineering Corp., Boston, MA (USA)). Dec 1987. Contract AC02-87CH10290;AC02-87CH10285. 61p. H. Order Number TI88011648/JAW.

The Site Study Plan for Meteorology/Air Quality describes a field program consisting of continuous measurements of wind speed and direction, temperature, humidity, dew point, and pressure neede for later modeling and dose calculations. These measurements will include upper level winds, vertical temperature structure, and vertical wind speed. All measurements will be made at a site located within the 9-m^2 site area but remote from the ESF. The SSP describes the need for each study; its design and design rationale; analysis, management, and use of data; schedule of field activities, organization of field personnel and sample management and quality assurance requirements. These studies will provide data needed to satisfy requirements contained in, or derived from, the Salt Repository Project Requirements Document. Although titled Meteorology/Air Quality, this SSP addresses only meteorology, as there are no air quality data needs in the SCP. A correction to the title will be made in a later revision. 27 refs., 6 figs., 3 tabs.

39300 **(BMI/ONWI/C—52) Basic repository environmental assessment design basis: Deaf Smith County site.** (Battelle Memorial Inst., Columbus, OH (USA). Office of Nuclear Waste Isolation; Stearns Catalytic Corp., Denver, CO (USA)). Mar 1988. Contract AC02-87CH10290. 232p. H. Order Number TI88011649/JAW.

This study examines the engineering factors and costs associated with the construction, operation, and decommissioning of a high-level nuclear waste repository in salt in the Palo Duro Basin in Deaf Smith County, Texas. The study assumes a repository capacity of 36,000 metric tons of heavy metal (MTHM) of unreprocessed spent fuel and 36,000 MTHM of commercial high-level reprocessing waste, along with 7,020 canisters of defense high-level reprocessing waste and associated quantities or remote- and contact-handled transuranic waste (TRU). With the exception of TRU,

all the waste forms are placed in 300- to 1000-year-life carbon-steel waste packages in a collocated waste handling and packaging facility (WHPF), which is also described. The construction, operation, and decommissioning of the proposed repository is estimated to cost approximately $4.64 billion. Costs include those for the collocate WHPF, engineering, and contingency, but exclude waste form assembly and shipment to the site and waste package fabrication and shipment to the site. These costs reflect the relative average wage rates of the region, the relatively easy access to the site, and the relatively weak nature of the salt at this site. Construction would require an estimated 7 to 7.5 years. Engineering factors and costs are not strongly influenced by environmental considerations. 62 refs., 24 figs., 20 tabs.

39301 **(BMI/ONWI/C—53) Site study plan for ecology, Deaf Smith County Site, Texas: Environmental Field Program: Preliminary Draft.** (Battelle Memorial Inst., Columbus, OH (USA). Office of Nuclear Waste Isolation). Jun 1987. Contract AC02-87CH10290. 92p. H. Order Number DE88011655/JAW.

The Ecology Site Study Plan describes a field program consisting of studies which include surveys for endangered, threatened, and candidate species; vegetation characterization, including mapping and cover typing, plant succession, wetlands description, and preexisting stresses; and wildlife community characterization, including availability and quality of habitats and descriptions of mammal, bird, reptile, amphibian, and invertebrate populations. The plan for each study describes the need for the study, study design, data management and use, schedule and personnel requirements, and quality assurance. These studies will provide data needed to satisfy requirements contained in, or derived from, the Salt Repository Project Requirements Document (SRP-RD). 83 refs., 3 tabs.

39302 **(BMI/ONWI/C—54-Rev.2) Evaluation of air quality and noise impact assessments, Deaf Smith County.** (Battelle Memorial Inst., Columbus, OH (USA). Office of Nuclear Waste Isolation). May 1986. Contract AC02-87CH10290. 106p. (BMI/ONWI—682-Rev.2). H. Order Number DE88012845/JAW.

In this report, several issues are identified regarding the air quality and noise impact assessments presented in the final salt repository environmental assessment (EA) prepared by the US Department of Energy for the Deaf Smith County, Texas, site. Necessary revisions to the data and methods used to develop the EA impact assessment are described. Then, a comparative evaluation is presented in which estimated impacts based upon the revised data and methods are compared with the impacts published in the EA. The evaluation indicates that the conclusions of the EA air quality and noise impacts sections would be unchanged. Consequently, the guideline findings presented in Chapter 6 of the EA are also unchanged by the revised analysis. 13 tabs.

39303 **(BMI/ONWI/C—56-Rev.2) Evaluation of air quality and noise impact assessments, Richton Dome: Revision 2.** (Battelle Memorial Inst., Columbus, OH (USA). Office of Nuclear Waste Isolation). May 1986. Contract AC02-87CH10290. 1019p. (BMI/ONWI—684-Rev.2). H. Order Number DE88012844/JAW.

In this report, several issues are identified regarding the air quality and noise impact assessments presented in the final salt repository environmental assessment (EA) prepared by the US Department of Energy for the Richton Dome, Mississippi, site. Necessary revisions to the data and methods used to develop the EA impact assessment are described. Then, a comparative evaluation is presented in which estimated impacts based upon the revised data and methods are compared with the impacts published in the EA. The evaluation indicates that the conclusions of the EA air quality and noise impacts sections would be unchanged. Consequently, the guideline findings presented in Chapter 6 of the EA are also unchanged by the revised analysis. 15 tabs.

39304 **(BMI/ONWI/C—60-Vol.1) Site characterization plan conceptual design report for a high-level nuclear waste repository in salt, vertical emplacement mode: Volume 1.** (Battelle Memorial Inst., Columbus, OH (USA). Office of Nuclear Waste Isolation; Fluor Technology, Inc., Irvine, CA (USA)). Dec 1987. Contract AC02-87CH10290;AC02-83WM46656. 545p. (DOE/CH/46656—15(1)). H. Order Number DE88013168/JAW.

This Conceptual Design Report describes the conceptual design of a high-level nuclear waste repository in salt at a proposed site in Deaf Smith County, Texas. Waste receipt, processing, packing, and other surface facility operations are described. Operations in the shafts underground are described, including waste hoisting, transfer, and vertical emplacement. This report specifically addresses the vertical emplacement mode, the reference design for the repository. Waste retrieval capability is described. The report includes a description of the layout of the surface, shafts, and underground. Major equipment items are identified. The report includes plans for decommissioning and sealing of the facility. The report discusses how the repository will satisfy performance objectives. Chapters are included on basis for design, design analyses, and data requirements for completion of future design efforts. 105 figs., 52 tabs.

39305 **(BMI/ONWI/C—70) Air pollutant emission rates for sources at the Richton Dome Repository Site.** (Battelle Columbus Div., OH (USA)). Nov 1985. Contract AC02-87CH10290. 239p. (BMI/ONWI—687). H. Order Number DE88012369/JAW.

The process of investigating air quality and noise impacts from site characterization and from repository development began with a set of construction/operation descriptions provided for the repository and for the exploratory shaft in early draft form. Air quality impacts resulting from these descriptions were developed. A document was prepared in response to the needs expressed after the completion of the first report. This present report is a revision of that second document. Many air pollutant emission estimates in this document differ from earlier estimates. The differences are the result of changes in the resources consumed, the equipment used, and the schedule of activities as well as information derived from recent studies of the control. The approach used in this report is to present all data and calculations in tabular form, the most economical means of presenting the large data set and calculations.

39306 **(BMI/ONWI/C—75) ERG [Engineering Review Group] and GRG [Geologic Review Group] review of the horizontal versus vertical modes of waste emplacement at the Deaf Smith County site, Texas.** Chytrowski, B.R. (Battelle Memorial Inst., Hereford, TX (USA). Office of Nuclear Waste Isolation). Jan 1988. Contract AC02-87CH10290;AC02-83CH10140. 69p. (BMI/ONWI—675). H;1. Order Number TI88012353/JAW.

The Engineering Review Group (ERG) and Geologic Review Group (GRG) were established by the Office of Nuclear Waste Isolation (ONWI) to help evaluate specific issues in the US Department of Energy's nuclear waste repository program. The December 1985 meeting and the February 1986 meeting dealt with the evaluation of the Fluor Technology, Inc., architect-engineer recommendation of the horizontal mode of waste package emplacement for the Site Characterization Plan Conceptual Design Report (SCP-CDR). The ONWI recommendation regarding horizontal and vertical modes of waste package emplacement and associated studies was reviewed. This report documents the ERG and GRG's comments and recommendations on this subject and ONWI responses to the specific points raised by these groups. The ERG and GRG joint review groups concurred with ONWI recommendations that additional studies are required in order to reach a decision on the method of emplacement to be used. In the opinion of these groups, both methods can be implemented; however, should the decision be reached today the vertical mode would be preferred.

39307 (BMI/ONWI/C—79) Geostatistical analysis of potentiometric data in the Pennsylvanian aquifer of the Palo Duro Basin, Texas. Harper, W.V.; Basinger, K.L.; Furr, J.M. (Battelle Memorial Inst., Hereford, TX (USA). Office of Nuclear Waste Isolation). Jan 1988. Contract AC02-87CH10290;AC02-83CH10140. 111p. (BMI/ONWI—680). H. Order Number TI88012826/JAW.

This report details a geostatistical analysis of potentiometric data from the Pennsylvanian aquifer in the Palo Duro Basin, Texas. Such an analysis is a part of an overall uncertainty analysis for a high-level waste repository in salt. Both an expected potentiometric surface and the associated standard error surface are produced. The Pennsylvanian data are found to be well explained by a linear trend with a superimposed spherical semivariogram. A cross-validation of the analysis confirms this. In addition, the cross-validation provides a point-by-point check to test for possible anomalous data. The analysis is restricted to that portion of the Pennsylvanian aquifer that lies to the southwest of the Amarillo Uplift. The Pennsylvanian is absent is some areas across the uplift and data to the northeast were not used in this analysis. The surfaces produced in that analysis are included for comparison. 9 refs., 15 figs.

39308 (BMI/ONWI/C—87) Influence of impurities on the creep of salt from the Palo Duro Basin. Hansen, F.D.; Senseny, P.E.; Pfeifle, T.W.; Vogt, T.J. (RE/SPEC, Inc., Albuquerque, NM (USA); Battelle Memorial Inst., Columbus, OH (USA). Office of Nuclear Waste Isolation). May 1987. Contract AC02-87CH10290;AC02-83CH10140. 82p. (BMI/ONWI—679). H. Order Number TI88012371/JAW.

Twelve triaxial compression creep tests were performed on salt specimens from the Woods-Holtzclaw well in the Palo Duro Basin to assess the influence of impurities on creep deformation. Four nominal impurity levels were initially selected for investigation: pure salt, salt containing 10% anhydrite, salt containing 10% mud, and salt containing 20% mud. Subsequent petrological measurements show these idealized categories do not exist. Composition of the samples was measured by methods of wet chemistry coupled with ethylene diaminetetraacetic acid (EDTA) digestion and point counting on full-size polished sections. Overall, the 12 specimens comprise 71.6--96.6% halite, 2.4--7.5% anhydrite, and 0.2--24.7% clay. Nine of the 12 specimens are similar to many other tested specimens from the Lower San Andres Unit 5. They range from 90--97% halite and average 94% with a standard deviation of 2%. The remaining 6% impurities are disseminated clay and anhydrite. The other three specimens from the Lower San Andres Unit 4 contain large amounts (average 20%) of uniformly distributed clays and average only 75% halite. 11 refs., 21 figs., 5 tabs.

39309 (BMI/ONWI/C—88) ISDOSE 3.0: A simple code to calculate inhalation and submersion dose equivalents from routine and accidental releases of radioactive material. Furr, J.M.; Mayberry, J.J. (Battelle Memorial Inst., Hereford, TX (USA). Office of Nuclear Waste Isolation). Dec 1987. Contract AC02-87CH10290. 61p. (BMI/ONWI/C—671). H. Order Number TI88012377/JAW.

The ISDOSE (Inhalation and Submersion DOSE equivalent) computer code was developed at Battelle Memorial Institute for the Office of Nuclear Waste Isolation to calculate submersion and inhalation doses from atmospheric releases of radionuclides from routine and unanticipated events during the preclosure phase at a nuclear waste repository. This user's manual presents the third version of the ISDOSE code (ISDOSE 3.0). ISDOSE is a simple code; i.e., it performs functions that can be verified easily by hand calculations. ISDOSE uses two dose conversion factor libraries: one for submersion dose conversion factors and one for inhalation dose conversion factors. The libraries contain data for 30 radionuclides that are of interest during the preclosure phase of the repository. The conversion factors are based on recommendations and dosimetric data published by the International Commission on Radiation Protection. The libraries contain both effective dose equivalent factors and dose equivalent factors for 11 organs. The inhalation dose equivalent factor library contains data for the different solubility classes of each radionuclide. ISDOSE can be set up to calculate a collective dose equivalent to a given population, or a maximum individual dose equivalent. The population distribution input parameter is in the form of a circular grid, which is divided into 16 sectors and 5 concentric annuli (i.e., 80 sections). A wind frequency input value is required for each of the sixteen sectors of the grid, and a ξ/Q value, the dispersion factor for airborne contaminants, is required for each of the 80 sections of the grid. 9 refs., 1 fig., 1 tab.

39310 (BMI/ONWI/C—92) First revision of the exponential-time creep law for Avery Island salt. Senseny, P.E.; Mellegard, K.D.; Pfeifle, T.W. (Battelle Memorial Inst., Columbus, OH (USA). Office of Nuclear Waste Isolation; RE/SPEC, Inc., Rapid City, SD (USA)). Jul 1985. Contract AC02-87CH10290;AC02-83CH10140. 24p. (BMI/ONWI—556). OSTI, PO Bx 62, Oak Ridge, TN 37831- Available from OSTI.. Order Number TI88012373/JAW.

Parameter values for the exponential-time law are presented for Avery Island salt. These parameter values supersede those given in a previous report. The parameter values given previously for Avery Island were determined from a data base that included results from a number of creep tests whose duration was too short to give valid constitutive parameters. The old data base was screened to eliminate invalid test results and several additional creep tests were performed to provide data at low temperature and low stress. Some of the new constitutive parameters are substantially different from those given previously. 8 refs., 9 figs., 3 tabs.

39311 (BMI/ONWI/C—93) PTRACK: A particle tracking program for evaluation travel path/travel time uncertainties. Thompson, B.M.; Campbell, J.E.; Longsine, D.E. (Battelle Memorial Inst., Hereford, TX (USA). Office of Nuclear Waste Isolation; INTERA Technologies, Inc., Houston, TX (USA)). Dec 1987. Contract AC02-87CH10290;AC02-83CH10140. 163p. (BMI/ONWI—674). H. Order Number TI88012366/JAW.

PTRACK is a model which tracks the path of a radionuclide particle released from a nuclear waste repository into a groundwater flow system in a two-dimensional representation of stratified geologic medium. The code calculates the time required for the particle to travel from the release point (the edge of the disturbed zone) to the specified horizontal or vertical boundary (the accessible environment). The physical properties of the geologic setting and the ground-water flow system can be treated as fixed values or as random variables sampled from their respective probability distributions. In the latter case, PTRACK assigns a sampled value for each parameter and tracks a particle for this trial (realization) of the system. Repeated realizations allow the effects of parameter uncertainty on travel paths/travel times to be quantified. The code can also calculate partial correlation coefficients between dependent variables and independent variables, which are useful in identifying important independent variables. This documentation describes the mathematical basis for the model, the algorithms and solution techniques used, and the computer code design. It also contains a detailed user's manual. The implementation of PTRACK is verified with several systems for which solutions have been calculated by hand. The integration of PTRACK with a Latin hypercube sampling (LHS) code is also discussed, although other sampling methods can be employed in place of LHS. 11 refs., 14 figs., 22 tabs.

39312 (BMI/ONWI/C—96) Technical procedure for transportation, Deaf Smith County site, Texas: Environmental Field Program: Final draft. (Morrison-Knudsen Engineers, Inc., San Francisco, CA (USA); Environmental Research and Technology, Inc., Concord, MA (USA)). Sep 1987. Contract AC02-87CH10290;AC02-83CH10140. 45p. H. Order Number TI88012363/JAW.

This Technical Procedures Manual (TP TR-5) is a description of five specific studies to be carried out within the site vicinity area. Primary emphasis is on studying various aspects of traffic characteristics on highways. All relate to traffic capacity in the site vicinity area. The studies are Continuous Automatic Counts, Manual Turning Movement Counts, Manual Counts by Vehicle Classification, Origin-Destination Studies, and Travel Time-Delay Route Studies. The purpose of TP TR-5 is to assemble a reliable data base for analyzing traffic in the site vicinity. The data collection activities for Survey Existing Information (TP T-1) will furnish some data that will be useful in the development of this set of data. Detailed field studies will be taken on the site vicinity routes to

provide baseline data for analyzing projected traffic impacts. Assembled data for projected repository activities will also furnish data on future needs which are important in analyzing total traffic impacts. 14 refs., 1 fig.

39313 (BMI/ONWI/C—97) Technical procedures for utilities & solid waste: Environmental Field Program, Deaf Smith County site, Texas: Final draft. (Battelle Memorial Inst., Columbus, OH (USA). Office of Nuclear Waste Isolation). Aug 1987. Contract AC02-87CH10290;AC02-83CH10140. 47p. H. Order Number TI88012356/JAW.

The evaluation of environmental issues and concerns and the addressing of statutory requirements are fundamental parts in the characterization of the site in Deaf Smith County, Texas for the US Department of Energy's Salt Repository Project (SRP). To ensure that the environmental field program comprehensively addresses the issues and requirements of the project, a site study plan (SSP) has been prepared for Utilities and Solid Waste considerations. This technical procedure (TP) has been developed to implement the field program described in the Utilities and Solid Waste Site Study Plan. The purpose and scope of the Utilities and Solid Waste Technical Procedure is to develop and implement a data collection procedure to fulfill the data base needs of the Utilities and Solid Waste SSP. The procedure describes a method of obtaining, assessing and verifying the capabilities of the regional service utilities and disposal contractors. This data base can be used to identify a preferred service source for the engineering contractor. The technical procedure was produced under the guidelines established in Technical Administrative Procedure No. 1.0, Preparation, Review and Approval of Technical Procedures.

39314 (BMI/ONWI/C—98) Preliminary review of retrieval issues for a high-level waste repository in salt. Smith, L.A. (Battelle Memorial Inst., Columbus, OH (USA). Office of Nuclear Waste Isolation). Nov 1985. Contract AC02-87CH10290. 45p. H. Order Number TI88012357/JAW.

This document highlights topics related to the retrieval of nuclear waste from a mined geological repository in salt. Retrieval is an event that, although it is not expected, must be planned for. Both high-level programmatic documents and Federal regulations require that the waste should be retrievable. It is therefore an important design consideration that the option exists to retrieve waste in the unlikely event retrieval is needed. There are several broad issues involved in a repository in salt that have significant implications to retrieval systems. Among these are high temperatures that can affect mining equipment operation and personnel safety; the viscoplastic behavior of salt that results in room closure and increased potential for unstable openings; and nuclear issues such as radiation and contamination, criticality, and accountability and safeguards. 31 refs., 2 figs., 1 tab.

39315 (BMI/ONWI/C—103-Rev.2) Historical seismicity of the Texas Panhandle from an examination of Lubbock seismographic station records: Revision 2: Topical report. Acharya, H. (Battelle Memorial Inst., Columbus, OH (USA). Office of Nuclear Waste Isolation; Stone and Webster Engineering Corp., Boston, MA (USA)). Sep 1987. Contract AC02-87CH10290;AC02-83CH10140. 37p. (ONWI/Sub—87/E512-05000-T33-Rev.2). H. Order Number TI88012830/JAW.

Seismicity data for the Texas Panhandle area are based on instrumental data and felt reports. Sparse population density and poor instrumental coverage of the area suggest that the data base may not be complete or reliable for small earthquakes. Film chips from the Lubbock Seismographic Station for the period of 1963-1980 were, therefore, examined to identify all earthquakes that had occurred in the Texas Panhandle during that period. Film chips of known events were also used to aid investigators in identifying characteristics of signals from earthquakes that occurred in the Panhandle. This examination identified 40 earthquakes that occurred within approximately 360 km of Lubbock during 1963-1980. These 40 earthquakes were not recorded by many stations and 38 of these were not located earlier. First motion amplitude and direction on all three components were measured for these earthquakes. Earthquakes that occurred north of Lubbock were identified on the basis of azimuth computation and were then approximately located using the time interval between the arrival of P and S phases. Application of a magnitude duration relationship that was developed in Oklahoma suggests a range of 1.6 to 4.5 for these earthquakes. This study suggests an activity rate of two to three earthquakes per year within about 360 km of Lubbock during 1963-1980. The study, therfore, shows that the area north of Lubbock Station, including the Texas Panhandle, is an area of low seismicity. 21 refs., 3 figs., 5 tabs.

39316 (BMI/ONWI/C—104) Hydrogeologic subdivision of the Wolfcamp Series and Pennsylvanian System of the Deaf Smith study area, Texas: Revision 1, Topical report. Siminitz, P.C.; Warman, E.A. (Battelle Memorial Inst., Columbus, OH (USA). Office of Nuclear Waste Isolation; Stone and Webster Engineering Corp., Boston, MA (USA)). Jul 1987. Contract AC02-87CH10290;AC02-87CH10285;AC02-83CH10140. 147p. (ONWI/SUB—87-E512-5000-T44). H. Order Number TI88012379/JAW.

The Pennsylvanian-Wolfcamp section in the Palo Duro Basin includes brine aquifers that are considered to be the most important ground-water flow paths in the deep-basin system. This particular study area comprises eight counties in Texas, centered in Potter County (and including Deaf Smith County). Underground patterns of rock distribution are delineated from a hydrologic perspective and at a level of detail appropriate for numerical modeling of regional ground-water flow. In this study, hydrogeologic units have been defined as mappable, physically continuous rock bodies that function in bulk as water-transmitting or water-retarding units relative to adjacent rocks. Interpretations are made primarily from geophysical logs. Hydrologic characteristics are assessed on the basis of properties typically associated with certain lithologies (e.g., sandstones are more pervious than shales) and on the basis of gross variations in effective porosity (particularly in carbonate sequences). In this report, the Pennsylvanian-Wolfcamp section is subdivided into 41 hydrogeologic units. These units do not constitute a classical or definitive breakdown of the Pennsylvanian-Wolfcamp section. 12 refs., 87 figs., 1 tab.

39317 (BMI/ONWI/C—113) Revised analysis of in-migrating workers during site characterization. (Battelle Memorial Inst., Columbus, OH (USA). Office of Nuclear Waste Isolation). Oct 1987. Contract AC02-87CH10290. 48p. H. Order Number TI88012834/JAW.

The Deaf Smith Environmental Assessment's analysis of in-migrating workers and community service impacts was predicated on the assumption that a peak of approximately 480 workers would be needed on location to conduct site characterization activities. This analysis assumed that DOE's prime contractor(s) would have a limited staff in the area; the majority of the workers would be on site for the construction of the exploratory shaft and to conduct geologic and environmental studies. Since the time when the Environmental Assessment was prepared, the prime contractors [Battelle-ISSC and the Technical Field Service Contractor (TFSC)] were requested to move their offices to the site area. Therefore, many more administrative and technical workers would be expected to relocate in the Deaf Smith County regions. A change in the expected number of in-migrants could also change the expected nature of community service impacts. It is the purpose of this analysis to evaluate the site characterization workforce and thresholds for local community services. 22 refs., 24 tabs.

39318 (BMI/ONWI/C—114) Results of readiness review for start of Title II Design of ESF in salt. (USDOE Office of Civilian Radioactive Waste Management, Columbus, OH. Salt Repository Project Office). 15 Apr 1986. Contract AC02-87CH10290. 61p. H;3. Order Number DE88012832/JAW.

The Readiness Review Board recommends that the ESF Title II Design be initiated after approval of revised Functional Design Criteria for Title II design. This review was conducted assuming a Deaf Smith location for ESF. Seventy-four open items and eight technical holds were identified during the Readiness Review that must be addressed and resolved to ensure successful completion of the ESF Title II Design. These items include definition and approval of surface based, EDH, and subsurface testing re-

quirements; development of an approved OCRWM/SRPO licensing position for the ESF; and acquisition and availability of site-specific confirmatory data. A Risk Assessment should be conducted to define corrective action data and technical, cost and schedule impacts and associated program risks of continuation of Title II design activities beyond those dates.

39319 **(BMI/ONWI/C—115) Exploratory Shaft Facility hoist recommendation: Revision 1.** (Battelle Memorial Inst., Hereford, TX (USA). Office of Nuclear Waste Isolation). Jul 1987. Contract AC02-87CH10290. 37p. H. Order Number TI88012827/JAW.

This report develops a project position and recommendation on the manner to provide hoisting capability at the Exploratory Shaft Facility (ESF) site during development, test support and decommissioning. The hoist study shows a clear preference for purchasing hoists over any option involving lease or rental costs. Given the planned duration of site characterization, government purchase will yield significantly lower total costs for the project. A decision analysis ranked this option on a relative 0 to 10 scale as a 7.6 versus 605 for the next best option. Double drum-double clutch, 1000 HP hoists are clearly preferable to single drum configurations and somewhat better than double drum-single clutch. While the purchase cost for this option is somewhat higher than the others, the benefits from increased versatility, minimum project schedule impact, and improved productivity favor the double clutch. This choice is favored for both construction and operations phases of the project. On a 0 to 10 scale the double drum-double clutch ranked 9.4 overall versus 8.68 for the double drum-single clutch option. Newly fabricated or suitable unused available hoists are favored over used hoists based on the reduced risks of breakdown, easier maintenance, warranty and start-up assistance availability and quality assurance. While new hoists will cost more to purchase and will require longer to procure, new hoists ranked 8.5 versus 7.3 for used hoists on the same 0 to 10 scale. Current project milestones provide adequate time for procurement.

39320 **(BMI/ONWI/C—125) An assessment of the adaptability and validity of the SocioEconomic Analysis of Repository Siting (SEARS) Modeling System: Summary report: Draft report.** Murdock, S.H.; Leistritz, F.L.; Hamm, R.R. (Texas A and M Univ., College Station (USA). Dept. of Rural Sociology; North Dakota State Univ., Fargo (USA). Dept. of Agricultural Economics). 27 Sep 1984. Contract AC02-87CH10290. 44p. H. Order Number TI88012828/JAW.

This report presents a summary of results of an assessment of the adaptability, sensitivity, and accuracy of the SEARS model. Specifically, after describing the methods used in the analysis, the report presents a discussion of each aspect of the model evaluation process. The adaptation of the system to three states (Louisiana, Wyoming, and Texas) is described in light of the three key aspects of model transfer: collection and preparation of input data, model code alterations, and resources required. The second major topic discussed is the sensitivity analysis, which consisted of evaluations of the model's ability to simulate the impact process and to show the expected the acuracy of the model. This analysis consisted of the projection of economic and demographic factors from 1970 to 1980, using data inputs for 1970, followed by comparisons of the model's projections to reported values from the 1980 Census and similar sources for regions, counties and cities in the three states. The analyses described in this report thus provide a comprehensive assessment of the SEARS methodology and one of the most complete and comprehensive assessments ever performed of the validity of a socioeconomic assessment model. 44 refs., 6 tabs.

39321 **(CAPE—3000) Neutron generator assembly (Engineering Materials).** Ortiz, J.; Trujillo, D. (Los Alamos National Lab., NM (USA)). 8 Jul 1987. Contract W-7405-ENG-36. 4 OSTI, PO Bx 62, Oak Ridge, TN 37831.

This documents provides engineering drawings of the neutron generator assembly which is used by the Los Alamos National Laboratory in its Differential Dieaway Technique/Waste Assay Instrument. (FI)

39322 **(CEA—11141) Study of microorganisms present in deep geologic formations.** Camus, H.; Lion, R.; Berthelin, J.; Desjardin, T.; Bianchi, A.; Garcin, J. (Commission of the European Communities, Luxembourg). 1987. 58p. (In French). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88752449/JAW.

This work has been executed in the scope of the studies on high activity radioactive wastes storage in deep geological environments. The authors make reference to an as complete as possible literature on the existence of microorganisms in those environments or under similar conditions. Then they describe the equipment and methods they have implemented to perform their study of the populations present in three deep-reaching drill-holes in Auriat (France), Mol (Belgique) and Troon (Great Britain). The results of the study exhibit the presence of a certain biological activity, well adapted to that particular life environment. Strains appear to be very varied from the taxonomic point of view and seemingly show an important potential of mineral alteration when provided with an adequate source of energy. Complementary studies, using advanced techniques such as those employed during the work forming the basis of this paper, seem necessary for a more accurate evaluation of long-term risks of perturbation of a deep storage site.

39323 **(CEA-CONF—9127) Prolixe-prototype reprocessing unit for irradiating wastes contamined with alpha emitters.** Madic, C.; Sontag, R. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. de Genie Radioactif). 1987. 4p. (CONF-870801—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88753881/JAW.

From International conference on nuclear fuel reprocessing and waste management (RECOD '87); Paris, France (24 Aug 1987).

A large number of hot cells are employed for research on nuclear fuel reprocessing and the production of isotope of transuranium elements. These activities generate solid wastes highly contaminated with alpha, beta, gamma emitters. The Prolixe hot cell was built in order to: 1/ reprocess the solid wastes contaminated with alpha, beta, gamma emitters produced in the Radiochemistry building: 2/ produce package wastes storable in shallow-ground disposal sites: 3/ develop a process sufficiently flexible to make it applicable to waste produced in other installations. The process is based on waste leaching after grinding. Depending on the type of wastes the leaching reactant will have a different composition 1/ nitric acid solution for cellulose waste: 2/ nitric solutions containing Ag(II) for other material. The complete process should achieve: 1/ a high waste volume reduction factor: 2/ the production of immobilized waste packages storage in shallow-ground disposal sites: 3/ the recycling of transuranium elements: 4/ the generation of a minimal volume of effluents. This process can be considered as an alternative process to incineration for the reprocessing of solid wastes highly contaminated with alpha, beta, gamma emitters.

39324 (CONF-871075—Vol.1-Pt.1, pp 3-25) **Oak Ridge waste disposal strategy.** Sleeman, R.C. Oct 1987. NTIS, PC A15/MF A01. Order Number DE88007803/JAW.

From 3. Oak Ridge model conference on waste problems; Oak Ridge, TN, USA (13 Oct 1987).

The Oak Ridge Operations Office has developed a strategy for the treatment and disposal of hazardous and radioactive waste. The basic philosophy behind the strategy is to detoxify and/or fix waste prior to disposal. Mixed waste will be detoxified to destroy the RCRA component and then handled as a low-level radioactive waste. A program to demonstrate detoxification technologies is underway. Low-level radioactive waste disposal strategies are being developed under the Low-Level Radioactive Waste Disposal Demonstration and Development (LLWDDD) Program. The ultimate goal of LLWDDD is to develop new, environmentally acceptable low-level waste disposal facilities for ORO. The LLWDDD strategy defines four classes of waste: (1) slightly contaminated radioactive waste, (2) short half-life radioactive waste, (3) long half-life material - primarily uranium, and (4) waste that cannot be disposed of on the Oak Ridge Reservation. Alternative technologies are being evaluated for each waste class. Disposal and treatment demonstrations are being carried out to demonstrate new technologies that will be required to implement the strategy.

39325 (CONF-871075—Vol.1-Pt.1, pp 27-42) **Environmental analyses for proposed Savannah River Plant waste management actions.** Jansen, J.R. Oct 1987. NTIS, PC A15/MF A01. Order Number DE88007803/JAW.

From 3. Oak Ridge model conference on waste problems; Oak Ridge, TN, USA (13 Oct 1987).

The Savannah River Plant (SRP) has been a major installation of the US Department of Energy (DOE) for the production of nuclear materials for national defense since the 1950's. Previously acceptable industrial activities conducted in support of the SRP mission have resulted in ground water and soil contamination at some SRP sites. DOE is preparing analyses of the environmental impacts of ongoing and planned waste management activities for hazardous, low-level radioactive, and mixed waste to provide a comprehensive framework within which future waste management activities can be evaluated, especially as these activities relate to the protection of ground water resources. This paper provides an overview of the analysis techniques, technical documentation, and environmental impact statement being prepared for proposed SRP waste management actions.

39326 (CONF-871075—Vol.1-Pt.1, pp 51-70) **In situ vitrification demonstration for the stabilization of buried wastes at the Oak Ridge National Laboratory.** Jacobs, G.K.; Spalding, B.P.; Carter, J.G.; Koegler, S.S. (Oak Ridge National Lab., TN (USA)). Oct 1987. NTIS, PC A15/MF A01. Order Number DE88007803/JAW. Contract AC05-84OR21400;AC06-76RL01830.

From 3. Oak Ridge model conference on waste problems; Oak Ridge, TN, USA (13 Oct 1987).

A demonstration of In Situ Vitrification (ISV) technology for the stabilization of radioactively contaminated soil sites at the Oak Ridge National Laboratory (ORNL) was successfully completed during July 1987. This demonstration is the first application of the ISV process not performed at the Hanford Site, where the technology was developed and patented by Pacific Northwest Laboratory (PNL). The joint ORNL-PNL pilot-scale demonstration was performed on a 3/8-scale trench (2 m deep x 1 m wide x 10 m long) that was constructed to simulate a typical seepage trench used for liquid low-level radioactive waste disposal at ORNL from 1951 to 1966. In the ISV process, electrodes are inserted around a volume of contaminated soil, power is applied to the electrodes, and the entire mass is melted from the surface of the soil down through the contaminated zone, thus making a glassy-to-microcrystalline waste form that incorporates the contaminants. Gases produced during the melting are collected, treated, monitored, and released through an off-gas process trailer. In the ORNL demonstration, a 25-t mass of melted rock approximately 1.2 m thick x 2.1 m wide x 4.9 m long was formed during 110 h of operation that consumed approximately 29 MWh of power. Data obtained on the operational performance of the test and waste-form durability will be used to assess the feasibility of applying the ISV technology to an actual waste trench.

39327 (CONF-871075—Vol.1-Pt.1, pp 71-85) **Mixed waste disposal facility at the Nevada Test Site.** Dickman, P.T.; Kendall, E.W. (Science Applications International Corp., Las Vegas, NV (USA)). Oct 1987. NTIS, PC A15/MF A01. Order Number DE88007803/JAW.

From 3. Oak Ridge model conference on waste problems; Oak Ridge, TN, USA (13 Oct 1987).

In 1984, a law suit brought against DOE resulted in the requirement that DOE be subject to regulation by the state and US Environmental Protection Agency (EPA) for all hazardous wastes, including mixed wastes. Therefore, all DOE facilities generating, storing, treating, or disposing of mixed wastes will be regulated under the Resource Conservation and Recovery Act (RCTA). In FY 1985, DOE Headquarters requested DOE low-level waste (LLW) sites to apply for a RCRA Part B Permit to operate radioactive mixed waste facilities. An application for the Nevada Test Site (NTS) was prepared and submitted to the EPA, Region IX in November 1985 for review and approval. At that time, the state of Nevada had not yet received authorization for hazardous wastes nor had they applied for regulatory authority for mixed wastes. In October 1986, DOE Nevada Operations Office was informed by the Rocky Flats Plant that some past waste shipments to NTS contained trace quantities of hazardous substances. Under Colorado law, these wastes are defined as mixed. A DOE Headquarters task force was convened by the Under Secretary to investigate the situation. The task force concluded that DOE has a high priority need to develop a permitted mixed waste site and that DOE Nevada Operations Office should develop a fast track project to obtain this site and all necessary permits. The status and issues to be resolved on the permit for a mixed waste site are discussed.

39328 (CONF-871075—Vol.1-Pt.1, pp 215-231) **Y-12 Plant waste minimization strategy.** Kane, M.A. (Martin Marietta Energy Systems, Inc., Oak Ridge, TN (USA)). Oct 1987. NTIS, PC A15/MF A01. Order Number DE88007803/JAW. Contract AC05-84OR21400.

From 3. Oak Ridge model conference on waste problems; Oak Ridge, TN, USA (13 Oct 1987).

The 1984 Amendments to the Resource Conservation and Recovery Act (RCRA) mandate that waste minimization be a major element of hazardous waste management. In response to this mandate and the increasing costs for waste treatment, storage, and disposal, the Oak Ridge Y-12 Plant developed a waste minimization program to encompass all types of wastes. Thus, waste minimization has become an integral part of the overall waste management program. Unlike traditional approaches, waste minimization focuses on controlling waste at the beginning of production instead of the end. This approach includes: (1) substituting nonhazardous process materials for hazardous ones, (2) recycling or reusing waste effluents, (3) segregating nonhazardous waste from hazardous and radioactive waste, and (4) modifying processes to generate less waste or less toxic waste. An effective waste minimization program must provide the appropriate incentives for generators to reduce their waste and provide the necessary support mechanisms to identify opportunities for waste minimization. This presentation focuses on the Y-12 Plant's strategy to implement a comprehensive waste minimization program. This approach consists of four major program elements: (1) promotional campaign, (2) process evaluation for waste minimization opportunities, (3) waste generation tracking system, and (4) information exchange network. The presentation also examines some of the accomplishments of the program and issues which need to be resolved.

39329 (CONF-871075—Vol.1-Pt.1, pp 233-263) **Process for volume reduction of solution recovery raffinate for the Portsmouth Gaseous Diffusion Plant (PORTS).** Bundy, R.D.; Alderfer, R.B. (Oak Ridge Gaseous Diffusion Plant, TN (USA)). Oct 1987. NTIS, PC A15/MF A01. Order Number DE88007803/JAW. Contract AC05-84OR21400.

From 3. Oak Ridge model conference on waste problems; Oak Ridge, TN, USA (13 Oct 1987).

A direct calcination process is being developed for the disposal of raffinate waste at PORTS. The present raffinate disposal process is a multistep treatment, which creates large volumes of solid waste. A one-step process should have lower operating costs and reduce waste volumes considerably. The flow sheet for the direct calcination process contains an evaporator for concentrating the raffinate, a condenser for condensing the water that is evaporated, a condensate cooler, a rotary kiln calciner, a water scrubber for removing the NO/sub x/ formed by the decomposition of nitrates during calcination, a refrigerated condenser for drying the gas leaving the water scrubber, chemical traps, and a HEPA filter. The feasibility of the direct calcination process was demonstrated in a bench-scale pot calcination system. The two primary requirements of the process were satisfied at a calcination temperature of 715°F: virtually all of the technetium was retained in the calcined solids while all of the nitrates were decomposed to oxides. The results of the bench-scale tests are being verified using a laboratory-scale rotary kiln calciner.

39330 (CONF-871075—Vol.1-Pt.1, pp 265-267) **Compaction of baled low level radioactive waste.** Arrowsmith, H.W. (Scientific Ecology Group Inc., Oak Ridge, TN (USA)). Oct 1987. NTIS, PC A15/MF A01. Order Number DE88007803/JAW.

From 3. Oak Ridge model conference on waste problems; Oak Ridge, TN, USA (13 Oct 1987).

The Scientific Ecology Group, demonstrated the feasibility of further volume reducing low level radioactive waste which was

previously baled to reduce its initial volume. The waste supplied for the evaluation consisted of 30" x 42" x 60" bales which were composed of paper, plastic, cloth, metal, glass, drums, and other miscellaneous materials contaminated with uranium 238 and trace amounts of uranium 235. The baled waste was processed by shredding the bales to reduce the size of the waste to fit into crushable innerpack boxes, compaction using SEG's 5000 ton Ultra-compactor, and overpacking into a 44 cubic foot burial module for transportation and burial. The resulting volume reduction factor was 3.3:1 over the volume of the baled waste and 33:1 over the initial loose waste at the generators site. The use of Ultra-compaction reduces the volume of waste that must be buried, improves the environmental performance of the waste after burial and extends the life of the burial site by burying less waste per year. If this program were fully utilized on one clients low level waste streams, it would require 42,000 cubic feet less burial ground space and would save an estimated $210,000 to $477,000 per year.

39331 (CONF-871075—Vol.1-Pt.1, pp 307-316) **Charging generators for waste management costs.** Berry, J.B.; Homan, F.J. (Oak Ridge National Lab., TN (USA)). Oct 1987. NTIS, PC A15/MF A01. Order Number DE88007803/JAW.

From 3. Oak Ridge model conference on waste problems; Oak Ridge, TN, USA (13 Oct 1987).

Charging waste management costs to generators creates an incentive to optimize processes so that less waste is produced and provides a basis for determining the cost effectiveness of capital improvements so that the mature phase of waste management can be attained. Improving waste management practices requires a long-range commitment and consistent administration. Making this commitment and providing adequate funding for proper waste disposal are more cost-effective measures than the alternative of paying for remedial actions after improper disposal. This paper summarizes (1) a plan to charge waste generators, (2) the administration structure of the plan, (3) a comparison between the rate structure and changes in waste disposal operations, and (4) issues that have surfaced as the plan is implemented.

39332 (CONF-871075—Vol.1-Pt.1, pp 317-319) **Waste management facility acceptance - some findings.** Sigmon, B. (Science Applications International Corp. (USA)). Oct 1987. NTIS, PC A15/MF A01. Order Number DE88007803/JAW.

From 3. Oak Ridge model conference on waste problems; Oak Ridge, TN, USA (13 Oct 1987).

Acceptance of waste management facilities remains a significant problem, despite years of efforts to reassure potential host communities. The tangible economic benefits from jobs, taxes, and expenditures are generally small, while the intangible risks of environmental or other impacts are difficult to evaluate and understand. No magic formula for winning local acceptance has yet been found. Limited case study and survey work does suggest some pitfalls to be avoided and some directions to be pursued. Among the most significant is the importance that communities place on controlling their own destiny. Finding a meaningful role for communities in the planning and operation of waste management facilities is a challenge that would-be developers should approach with the same creativity that characterizes their technical efforts.

39333 (CONF-871075—Vol.1-Pt.1, pp 323-331) **Permitting and the public.** Garrett, J.; Stephens, R.D. (International Technology Corp., Knoxville, TN (USA)). Oct 1987. NTIS, PC A15/MF A01. Order Number DE88007803/JAW.

From 3. Oak Ridge model conference on waste problems; Oak Ridge, TN, USA (13 Oct 1987).

Community Relations and Permitting have both been around a long time. They have existed primarily as separate programs coming together only at the time of official public hearings or when public opposition surfaced in relation to a particular permitting effort. IT has linked Community Relations and Permitting in a program designed to overcome or minimize public opposition to the siting of hazardous waste treatment facilities. IT's Technology Projects group has been created to commercialize new and innovative hazardous waste treatment technologies both for fixed facilities and for Superfund remediation projects. The Permitting and Community Relations efforts are begun at the time of site selection and proceed as an integrated program through construction and operation. The Community Relations Manager and the Permitting Manager work as a team with regulatory authorities and the community, reshaping and recasting the community awareness program to communicate the project goals and corporate commitment to the community. The permitting program is altered in response to comments received from the community and regulatory officials. The end product is a permitted operating facility with public acceptance and the operating flexibility.

39334 (CONF-871075—Vol.1-Pt.1, pp 345-368) **University program in hazardous chemical and radioactive waste management.** Parker, F.L. (Vanderbilt Univ., Nashville, TN (USA)). Oct 1987. NTIS, PC A15/MF A01. Order Number DE88007803/JAW.

From 3. Oak Ridge model conference on waste problems; Oak Ridge, TN, USA (13 Oct 1987).

The three main functions of a university program are education, training, and research. At Vanderbilt University, there is a Solid and Hazardous Waste option in the Master of Science in Engineering Program. The two main foci are treatment of wastes and environmental transport and transformation of the wastes. Courses in Hazardous Waste Engineering and Radioactive Waste Disposal present a synoptic view of the field, including legal, economic, and institutional aspects as well as the requisite technical content. The training is accomplished for some of the students through the aegis of an internship program sponsored by the US Department of Energy. In the summer between the two academic years of the program, the study works at a facility where decontamination and/or decommissioning and/or remedial actions are taking place. Progress in understanding the movement, transformation, and fate of hazardous materials in the environment is so rapid that it will not be possible to be current in the field without participating in that discovery. Therefore, their students are studying these processes and contributing to new knowledge. Some recent examples are the study of safety factors implicit in assuming a saturated zone below a hazardous waste landfill when an unsaturated zone exists, application of probabilistic risk assessment to three National Priority List sites in Tennessee, and the explanation of why certain organics precede pH, conductivity and nitrates through a clay liner at a hazardous waste disposal site.

39335 (CONF-871075—Vol.1-Pt.1, pp 369-383) **Interpreting the SARA and RCRA training requirements.** Moreland, W.M.; Wells, S.M. (Oak Ridge National Lab., TN (USA)). Oct 1987. NTIS, PC A15/MF A01. Order Number DE88007803/JAW. Contract AC05-84OR21400.

From 3. Oak Ridge model conference on waste problems; Oak Ridge, TN, USA (13 Oct 1987).

The Resource Conservation and Recovery Act (RCRA) and the Superfund Amendments and Reauthorization Act (SARA) promulgated by the EPA (RCRA) and the OSHA (SARA) require hazardous materials training for all individuals working with hazardous materials. Facilities that are involved in the generation, storage, treatment, transportation, or disposal/removal of hazardous materials/waste must comply with all relevant training regulations. Using the guidelines contained in the RCRA and SARA regulations, decisions must be made to determine: the type of regulatory requirement based on facility function (i.e., whether the facility is a RCRA or CERCLA facility). The type of training required for specific categories of workers (e.g. managers, supervisors, or general site workers). The level of training needed for each category of worker. This presentation outlines how the Environmental Compliance and Health Protection Technical Resources and Training Group, working with waste operations personnel, establishes specific training requirements.

39336 (CONF-880277—1) **Site characterization and modeling to estimate movement of hazardous materials in groundwater.** Ditmars, J.D. (Argonne National Lab., IL (USA)). 1988. 11p. NTIS, PC A03;3. Order Number DE88010073/JAW.

From Pacific Basin conference on hazardous waste; Honolulu, HI, USA (1 Feb 1988).

A quantitative approach for evaluating the effectiveness of site characterization measurement activities is developed and illus-

trated with an example application to hypothetical measurement schemes at a potential geologic repository site for radioactive waste. The method is a general one and could also be applied at sites for underground disposal of hazardous chemicals. The approach presumes that measurements will be undertaken to support predictions of the performance of some aspect of a constructed facility or natural system. It requires a quantitative performance objective, such as groundwater travel time or contaminant concentration, against which to compare predictions of performance. The approach recognizes that such predictions are uncertain because the measurements upon which they are based are uncertain. The effectiveness of measurement activities is quantified by a confidence index, β, that reflects the number of standard deviations separating the best estimate of performance from the perdetermined performance objective. Measurements that reduce the uncertainty in predictions lead to increased values of β. The link between measurement and prediction uncertainties, required for the evaluation of β for a particular measurement scheme, identifies the measured quantities that significantly affect prediction uncertainty. The components of uncertainty in those key measurements are spatial variation, noise, estimation error, and measurement bias. 7 refs., 4 figs.

39337 **(DOE/CH/46656—02) List of regulations pertaining to safeguards and security: Engineering study report.** (Battelle Memorial Inst., Columbus, OH (USA). Office of Nuclear Waste Isolation; Fluor Technology, Inc., Irvine, CA (USA)). May 1987. Contract AC02-87CH10290;AC02-83WM46656. 25p. (BMI/ONWI/C—89). H. Order Number TI88012376/JAW.

This report identifies the regulations and requirements pertaining to safeguards and security that are applicable to the Salt Repository. The report documents the results of a study initiated at the request of DOE to review regulations and requirements of the DOE, NRC, and IAEA. For the purpose of this DOE initiated work, safeguards is equated to nuclear material control and accounting systems rather than the more general term safeguards, as defined in Section 2.1 and described in the Atomic Energy Act of 1954 (AEA). NRC regulations contained in Title 10, Code of Federal Regulations---Energy, Parts 0-199, are identified and their applicability to repository safeguards and security are discussed. Part 75, Safeguards of Nuclear Material, is included in this review since this part implements the US/IAEA agreement for certain NRC Licensed facilities. The NRC regulation 10 CFR 60, Disposal of High-Level Radioactive Wastes in Geologic Repositories, governs the design and licensing of the Salt Repository. In this regulation, the DOE is to provide at the geologic repository operations area such safeguards as it requires at comparable surface facilities (of DOE) to promote the common defense and security. It is concluded that DOE Orders represent the requirements and documentations regarding safeguards and security that are applicable to the Salt Repository.

39338 **(DOE/CH/46656—05) Mined salt storage feasibility: Engineering study report.** (Fluor Technology, Inc., Irvine, CA (USA)). Jul 1987. Contract AC02-87CH10290;AC02-83WM46656. 27p. (BMI/ONWI/C—91). Unlimited audience, publicly available.. Order Number TI88012374/JAW.

This study addresses a method of eliminating the surface storage of mined salt at the Deaf Smith repository site. It provides rough estimates of the logistics and costs of transporting 3.7 million tons of salt from the repository to the salt disposal site near Carlsbad, New Mexico and returning it to the repository for decommissioning backfill. The study assumes that a railcar/truck system will be installed and that the excavated salt will be transported from the repository to an existing potash mine located near Carlsbad, New Mexico approximately 300 miles from the repository. The 3.7 million tons of salt required for repository decommissioning backfill can be stored in the potash mines along with the excess salt, with no additional capital costs required for either a railcar or a truck transportation system. The capital cost for facilities to reclaim the 3.7 million tons of salt from the potash mine is estimated to be $4,400,000 with either a rail or truck transportation system. Segregating the 3.7 million tons of backfill salt in a surface storage area at the potash mine requires a capital cost of $13,900,000 with a rail system or $11,400,000 with a truck system. Transportation costs are estimated at $0.08/ton-mile for rail and $0.13/ton-mile for truck. 2 figs., 5 tabs.

39339 **(DOE/CH/46656—14(1)) Site characterization plan conceptual design report for a high-level nuclear waste repository in salt, horizontal emplacment mode: Volume 1.** (USDOE Office of Civilian Radioactive Waste Management, Columbus, OH. Salt Repository Project Office; Fluor Technology, Inc., Irvine, CA (USA)). Dec 1987. Contract AC02-87CH10290;AC02-83WM46656. 540p. (BMI/ONWI/C—127-Vol.1). OSTI, PO Bx 62, Oak Ridge, TN 37831-Available from OSTI.;3. Order Number DE88012841/JAW.

This Conceptual Design Report describes the conceptual design of a high-level nuclear waste repository in salt at a proposed site in Deaf Smith County, Texas. Waste receipt, processing, packaging, and other surface facility operations are described. Operations in the shafts and underground are described, including waste hoisting, transfer, and horizontal emplacement. This report specifically addresses the horizontal emplacement mode, the passive alternate design for the repository. Waste retrieval capability is described. The report includes a description of the layout of the surface, shafts, and underground. Major equipment items are identified. The report includes plans for decommissioning and sealing of the facility. The report discusses how the repository will satisfy performance objectives. Chapters are included on basis for design, design analyses, and data requirements for completion of future design efforts. 105 figs., 52 tabs.

39340 **(DOE/CH/46656—15(2)) Site characterization plan conceptual design report for a high-level nuclear waste repository in salt, vertical emplacement mode: Volume 2.** (Fluor Technology, Inc., Irvine, CA (USA)). Dec 1987. Contract AC02-87CH10290;AC02-83WM46656. 531p. (BMI/ONWI/C—60-Vol.2). H;1. Order Number TI88012847/JAW.

Chapter 6 discusses the repository design features and operating procedures that will be used to ensure compliance with regulatory limits for preclosure releases, performance objectives for waste retrieval, and performance objectives for postclosure or long-term waste isolation. Chapter 7 discusses the analyses that were conducted in developing the repository design and the impacts of various external factors on the design of repository elements and the repository as a whole. Chapter 8 discusses the engineering design information needs that were identified during conceptual design as necessary to advance the current conceptual design to License Application Design (LAD). The quality assurance (QA) program applicable to the Architect/Engineer (A/E) activities during the repository conceptual design effort is defined in Chapter 9. 146 refs., 44 figs., 21 tabs.

39341 **(DOE/CH/46656—16-Rev.0) Salt Repository Project shaft design guide: Revision 0.** (Fluor Technology, Inc., Irvine, CA (USA)). Dec 1987. Contract AC02-87CH10290;AC02-83WM46656;AC97-86WM46664. 261p. (BMI/ONWI/C—57). OSTI, PO Bx 62, Oak Ridge, TN 3783112;1; GPO Dep. Order Number DE88012368/JAW.

The Salt Repository Project (SRP) Shaft Design Guide (SDG) and the accompanying SRP Input to Seismic Design define the basic approach for developing appropriate shaft designs for a high-level nuclear waste repository in salt at a proposed site in Deaf Smith County, Texas. The SDG is based on current mining industry standards and practices enhanced to meet the special needs of an underground nuclear waste repository. It provides a common approach for design of both the exploratory and repository shafts. The SDG defines shaft lining and material concepts and presents methods for calculating the loads and displacements that will be imposed on lining structures. It also presents the methodology and formulae for sizing lining components. The SDG directs the shaft designer to sources of geoscience and seismic design data for the Deaf Smith County, Texas repository site. In addition, the SDG describes methods for confirming shaft lining design by means of computer analysis, and it discusses performance monitoring needs that must be considered in the design. 113 refs., 18 figs., 14 tabs.

39342 **(DOE/CH/46656—17-Rev.0) Salt Repository Project input to seismic design: Revision 0.** (USDOE Office of Civilian Radioactive Waste Management, Columbus, OH. Salt Repository Project Office; Fluor Technology, Inc., Irvine, CA (USA); Parsons-Brinckerhoff, New York (USA)). Dec 1987. Contract AC02-87CH10290;AC02-83WM46656;AC97-86WM46664. 132p. (BMI/ONWI/C—55). OSTI, PO Bx 62, Oak Ridge, TN 37831- Available from OSTI.. Order Number TI88012367/JAW.

The Salt Repository Program (SRP) Input to Seismic Design (ISD) documents the assumptions, rationale, approaches, judgments, and analyses that support the development of seismic-specific data and information to be used for shaft design in accordance with the SRP Shaft Design Guide (SDG). The contents of this document are divided into four subject areas: (1) seismic assessment, (2) stratigraphy and material properties for seismic design, (3) development of seismic design parameters, and (4) host media stability. These four subject areas have been developed considering expected conditions at a proposed site in Deaf Smith County, Texas. The ISD should be used only in conjunction with seismic design of the exploratory and repository shafts. Seismic design considerations relating to surface facilities are not addressed in this document. 54 refs., 55 figs., 18 tabs.

39343 **(DOE/ER—0364) Site-directed subsurface environmental initiative: Five year summary and plan for fundamental research in subsoils and in groundwater, FY 1989-FY 1993.** (USDOE Office of Energy Research, Washington, DC. Office of Health and Environmental Research). Apr 1988. 54p. NTIS, PC A04/MF A01;1; GPO Dep. Order Number DE88010961/JAW.

The initiative represents a commitment on the part of the Office of Energy Research to use national laboratory resources and specific university expertise to markedly advance the scientific and technological knowledge required to resolve critical environmental concerns. The mixed nuclear and chemical wastes generated by DOE operations contain chemicals common to wastes from most US industries. Furthermore, the wastes share the potential for contamination of major US aquifers. This initiative will, therefore, provide information needed to resolve issues associated with waste disposal at the national level. The overall goal of this research initiative is to develop the necessary scientific basis for resolution of key technical obstacles to defining and remediating contamination at DOE and other waste sites. To accomplish this goal, the resources of the national laboratories, universities, and DOE sites will be fully utilized to develop and demonstrate improved, cost-effective, and environmentally acceptable techniques for predicting the behavior of contaminants and reducing their concentrations in groundwater. The document that follows is a preliminary plan to set general research directions for a program extending into the 1990s; detailed plans and priorities will come later. 2 figs.

39344 **(DOE/HWP—26) SRS: Site ranking system for hazardous chemical and radioactive waste.** Rechard, R.P.; Chu, M.S.Y.; Brown, S.L. (Sandia National Labs., Albuquerque, NM (USA)). May 1988. Contract AC04-76DP00789. 294p. (SAND—86-2994). NTIS, PC A13/MF A01;1; GPO Dep. Order Number DE88013000/JAW.

This report describes the rationale and presents instructions for a site ranking system (SRS). SRS ranks hazardous chemical and radioactive waste sites by scoring important and readily available factors that influence risk to human health. Using SRS, sites can be ranked for purposes of detailed site investigations. SRS evaluates the relative risk as a combination of potentially exposed population, chemical toxicity, and potential exposure of release from a waste site; hence, SRS uses the same concepts found in a detailed assessment of health risk. Basing SRS on the concepts of risk assessment tends to reduce the distortion of results found in other ranking schemes. More importantly, a clear logic helps ensure the successful application of the ranking procedure and increases its versatility when modifications are necessary for unique situations. Although one can rank sites using a detailed risk assessment, it is potentially costly because of data and resources required. SRS is an efficient approach to provide an order-of-magnitude ranking, requiring only readily available data (often only descriptive) and hand calculations. Worksheets are included to make the system easier to understand and use. 88 refs., 19 figs., 58 tabs.

39345 **(DOE/ID/12476—T2) Low-level radioactive waste shipping document requirements: [Final report].** (Inter/Face Associates (USA)). Sep 1987. Contract FG07-83ID12476. 74p. NTIS, PC A04. Order Number DE88010802/JAW.

This report compares the way various items of information are presented on a draft nationally uniform low-level radioactive waste (LLW) manifest developed by the Western Governors Association (WGA) in 1986 and on the two existing manifest forms developed by the current LLW disposal facility operators, Chem-Nuclear Systems, Inc. and US Ecology, Inc. The information items that are required by regulation are covered in Chapter 2 and are presented with their regulatory citations and their item numbers on the three manifests (proposed WGA Uniform Manifest, Chem-Nuclear Manifest and US Ecology Manifest). The information items are not required by regulation but are necessary for a manifest to function properly and to serve its intended purpose are covered in Chapter 3 and with their item numbers on the three manifests. Items that would be useful to have on a manifest but that are neither required nor necessary are covered in Chapter 4. Items that are on one or more of the three manifests but that are not required by regulation, are not necessary for a manifest to function properly or to serve its intended purpose and are not useful to the actual or potential users of information contained on a manifest are covered in Chapter 5.

39346 **(DOE/ID/12576—T4) Regional Management Plan: Summary report.** Drobny, N.L. (Midwest Interstate Low-Level Radioactive Waste Commission, St. Paul, MN (USA); ERM-Midwest, Inc., Columbus, OH (USA)). 1 Aug 1986. Contract FG07-85ID12576. 91p. NTIS, PC A05/MF A01;1; GPO Dep. Order Number DE88008161/JAW.

This summary report describes the results of a 16-month project to develop a Regional Management Plan for low-level radioactive waste management in a seven-state area. The seven states are Indiana, Iowa, Michigan, Minnesota, Missouri, Ohio, and Wisconsin. These states have formed the Midwest Interstate Low-Level Radioactive Waste Commission in accord with Congressional requirements established in 1980. 14 refs., 13 figs., 9 tabs.

39347 **(DOE/IG—0253) Integration of defense waste into the Civilian Repository Program.** (Department of Energy, Washington, DC (USA). Office of Inspector General). 24 Mar 1988. 14p. H. Order Number TI88008585/JAW.

Report to The Secretary.

The purpose of this audit was to determine whether the fee calculation method proposed by Waste Management would result in an accurate and fair allocation of costs to both civilian and defense owners of nuclear waste. We reviewed Waste Management's proposed cost allocation plans to be used in calculating fees for defense waste disposal. We also evaluated Waste Management's actions toward developing a defense waste fee payment schedule. Our examination was made in accordance with generally accepted government auditing standards which included tests of internal controls and compliance with laws and regulations to the extent necessary to satisfy the scope of the audit.

39348 **(DOE-RW—86.045) Thermal monitoring of the cement checking Exotherm and its application to the quality of cemented wastes.** Walters, S.G.; Wells, D.A. (Department of the Environment, London (UK); UKAEA Atomic Energy Establishment, Winfrith). Feb 1988. 21p. (AEEW-R—2304; ILWRP—85-P26). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88754097/JAW.

This report describes a preliminary evaluation of the possible techniques for monitoring the cement exotherm as a possible method of confirming the quality of a particular mix.

39349 **(DOE-RW—88.051) Development of the CHEMTARD coupled process simulator for use in radiological assessment.** Liew, S.K.; Read, D. (Department of the Environment, London (UK); Atkins (W.S.) and Partners, Epsom (UK)). Dec 1987. 150p. (WSA-TR—20). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88754099/JAW.

This report describes features of CHEMTARD (Chemical Transport Adsorption Redox and Decay); a directly-coupled chemical transport code, developed to aid the DOE in carrying out post-closure radiological risk assessments. The program is based on the Lawrence Berkeley code, CHEMTRN, and simulates the one-dimensional transport of aqueous chemical species by advection and/or diffusion while accounting for phase transfer by reversible precipitation-dissolution, ion-exchange or surface adsorption. New models for radioactive decay, oxidation-reduction reactions, flexible boundary conditions and multi-layered transport have significantly enhanced the ability of the code to perform coupled process calculations. Although originally developed for studies involving shallow disposal of low level wastes, the models contained in CHEMTARD are sufficiently general to allow thermodynamic treatment of chemical transport for porous flow through all saturated aquifer systems.

39350 (DOE/RW—0160-Vol.2) Site characterization plan: Yucca Mountain site, Nevada research and development area, Nevada: Consultation draft, Nuclear Waste Policy Act: Volume 2. (USDOE Office of Civilian Radioactive Waste Management, Washington, DC). Jan 1988. Contract AC08-87NV10576. 588p. H. Order Number TI88007743/JAW.

The Yucca Mountain site in Nevada is one of three candidate sites for the first geologic repository for radioactive waste. On May 28, 1986, it was recommended for detailed study in a program of site characterization. This site characterization plan (SCP) has been prepared in accordance with the requirements of the Nuclear Waste Policy Act to summarize the information collected to date about the geologic conditions at the site; to describe the conceptual designs for the repository and the waste package and to present the plans for obtaining the geologic information necessary to demonstrate the suitability of the site for a repository, to design the repository and the waste package, to prepare an environmental impact statement, and to obtain from the US Nuclear Regulatory Commission (NRC) an authorization to construct the repository. Chapter 3 summarizes present knowledge of the regional and site hydrologic systems. The purpose of the information presented is to (1) describe the hydrology based on available literature and preliminary site-exploration activities that have been or are being performed and (2) provide information to be used to develop the hydrologic aspects of the planned site characterization program. Chapter 4 contains geochemical information about the Yucca Mountain site. The chapter references plan for continued collection of geochemical data as a part of the site characterization program. Chapter 4 describes and evaluates data on the existing climate and site meterology, and outlines the suggested procedures to be used in developing and validating methods to predict future climatic variation. 534 refs., 100 figs., 72 tabs.

39351 (DOE/RW—0187) Draft 1988 mission plan amendment. (USDOE Office of Civilian Radioactive Waste Management, Washington, DC). Jun 1988. 108p. H. Order Number TI88012344/JAW.

This draft 1988 amendment to the Mission Plan for the Civilian Radioactive Waste Management Program has been prepared by the US Department of Energy (DOE). The purpose is to inform the Congress of the DOE's plans for implementing the provisions of the Nuclear Waste Policy Amendments Act of 1987 (P.L. 100-203) for the Civilian Radioactive Waste Management Program. This document is being submitted in draft form to Federal agencies, states, previously affected Indian Tribes, affected units of local government, and the public. After the consideration of comments, this amendment will be revised as appropriate and submitted to the Congress. 39 refs., 7 figs., 4 tabs.

39352 (DOE/RW—0190) Nuclear Waste Fund cash management procedures. (USDOE Office of Civilian Radioactive Waste Management, Washington, DC). Apr 1988. 14p. OSTI, PO Bx 62, Oak Ridge, TN 37831- Available from OSTI.. Order Number TI88010336/JAW.

The Nuclear Waste Policy Act if 1982 (NWPA) provided for the Office of Radioactive Waste Management (OCRWM) to adopt financial and accounting methods comparable to those used by private industry, including borrowing and investing authority. This document describes the procedures OCRWM follows to meet its borrowing and investing authority under the NWPA. These procedures are a supplement to, and are, therefore, not intended to supersede, existing Departmental policies and procedures.

39353 (DP-MS—88-56) Dispersion of HT [elemental tritium] and HTO [tritium oxide] following an unplanned release of tritium to the atmosphere. Kurzeja, R.J.; Murphy, C.E. Jr.; Taylor, R.W. (Savannah River Lab., Aiken, SC (USA)). 1988. Contract AC09-76SR00001. 9p. (CONF-880505—16). NTIS, PC A02/MF A01;1; GPO Dep. Order Number DE88008351/JAW.

From 3. topical meeting on tritium technology in fission, fusion and isotopic applications; Toronto, Canada (1 May 1988).

An unplanned release of 168,000 Ci of elemental tritium (HT) and 4700 Ci of tritium oxide (HTO) occurred on July 31, 1987 from the Savannah River Plant. The oxide fraction in the exhaust stack was determined to be 2.7%. The air concentrations of HT and HTO were also measured at 43 downwind locations. The oxide fraction varied between 2 and 3% at the plant boundary (12 miles downwind) and between 0.3% and 84% at greater downwind distances (15 to 40 miles). The increased variability of the oxide fraction with downwind distance is attributed to exchange of oxide with surface vegetation and to turbulent transfer between the surface and the boundary layer. These results are relevant to a recent study of HT oxidation based on downwind changes in the HT/HTO ratio (Bardolle, 1985). 6 refs., 3 figs.

39354 (DPST—88-371) Waste tank roof slab resistance to sudden loads. Yau, W.W.F. (Savannah River Lab., Aiken, SC (USA)). 2 Mar 1988. Contract AC09-76SR00001. 2p. NTIS, PC A02/MF A01;1; GPO Dep. Order Number DE88011087/JAW.

The Department of Energy has requested that the Safety Analysis Report include an analysis of a tank top collapse event due to equipment overload. The overload is defined as a 3-ton truck plunging suddenly onto the tank roof. This memorandum reports the findings of a simplified analysis of the roof structure of a Type III waste tank. Based on a simplified and conservative analysis of the roof slab of a Type III waste tank, the reinforced concrete design is resistant to the impact loading of a 3-ton truck with a safety factor of at least five against large scale inelastic deformation.

39355 (DPST—88-475) List of reference documents resulting from Environmental Sciences Division support of the waste management activities for groundwater protection environmental impact statement. Looney, B.B. (Savannah River Lab., Aiken, SC (USA)). 14 Apr 1988. Contract AC09-76SR00001. 12p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88010707/JAW.

The subject EIS is a large and complex document that contains assessments of closure options for seventy-seven existing "waste sites" located at approximately forty-five locations across SRP, disposal options for disassembly basin purge water, and design and operation of new waste management facilities. Several groups within the Savannah River Laboratory (SRL) and SRP performed the environmental assessments that NUS incorporated into the draft and final EIS. For example, Interim Waste Technology in SRL (and their subcontractors) performed the assessments related to the new facilities, the Environmental Sciences Division in SRL (and their subcontractors) performed the assessments related to existing waste sites and generally defined the methods to be used for the various assessments, and the NEPA group in SRP coordinated cost estimates and Du Pont comments on the EIS. The staff and budget requirements associated with the EIS support were very large; now that the process is complete, it is appropriate to document the result of this investment. Attached is a listing of the documents produced to support the EIS by the Environmental Sciences Division or its subcontractors/associates. Note that these documents cover a wide range of topics (e.g., ecology, geochemistry, health risk factors, etc.). Other Du Pont groups also published support documents. 120 refs.

39356 **(ENEA-RT-PAS—87-17) Compatibility of cement with low and medium level wastes generated at nuclear power plants.** De Angelis, G. (ENEA, Rome (Italy)). 1987. 16p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88701561/JAW.

The incorporation of low- and medium level wastes in cement can give rise to serious problems due to the interaction between radwastes and cement components. Some troubles can occur during the first stages of the cementation process while deleterious phenomena come into evidence in the medium and long term. With the aim to improve the quality of the final waste forms a pretreatment of the waste streams is often necessary, as well as the addition of special agents to the cement matrix. The prediction of the long-term behaviour of the final products is of main importance in this research field. To this purpose some accelerated tests have been proposed, but much effort should be further devoted to the comprehension of the waste/matrix interaction. In this paper the principal waste streams are reviewed together with the possible remedies which seem to be more suitable for their cementation. Thus the qpportunity of separatly handling and solidifying different types of waste is once more supported.

39357 **(EUR—10853) Feasibility study on a tomograph for radioactive waste examination.** Montigon, J.F. (Commission of the European Communities, Luxembourg). 1987. 91p. (In French). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88753948/JAW.

A feasibility study on a high-energy tomograph for radioactive waste examination has been carried out by CEA/SEDFMA (Cadarache, France). After describing the scope of the research (radiation source, detector system, data processing, station mechanics), this final report deals with the work programme which has been followed and gives the results of the research. The conclusion is that such a tomograph is feasible, and its preliminary design is shown. The main points are that: - the detector material will be BGO, - the transmission of gamma rays through concrete (up to 1 625 mm thick) has been measured and a calculation code has been validated, - the radiation source will be an accelerator which has to be carefully optimized, - the system configuration has been determined and the data processors have been chosen, - the algorithms for image reconstruction have been validated through taking a tomogram on a concrete sample.

39358 **(GESD—88-49) AECL-US/DOE Radioactive Waste Management Technical Cooperation Program, 1985-1989: Subsidiary agreement No. 1: Quarterly report to March 31, 1988.** (Atomic Energy of Canada Ltd., Pinawa, Manitoba. Whiteshell Nuclear Research Establishment; USDOE Chicago Operations Office, Argonne, IL). Apr 1988. 46p. NTIS, PC A03;3. Order Number DE88012292/JAW.

Progress is briefly reported in the following collaboarative research programs between the United States Department of Energy (US DOE) and the Atomic Energy of Canada LTD (AECL); Exploratory/hydrogeology boreholes; Excavation Response Experiment; Heated block experiment; Heated pressure chamber experiment; Buffer/container equipment; and Borehole Scaling investigations. Field testing Investigations are also briefly discussed in the area of corehole hydological testing. Various projects of shaft extension and characterization are also addressed. (CBS)

39359 **(GSF—24/87) Radiation protection and environmental monitoring in the area of the Asse shaft plant. Annual report 1986.** Mueller-Lyda, I.; Meyer, H. (Gesellschaft fuer Strahlen- und Umweltforschung m.b.H. Muenchen, Neuherberg (Germany, F.R.); Gesellschaft fuer Strahlen- und Umweltforschung m.b.H. Muenchen, Braunschweig (Germany, F.R.). Inst. fuer Tieflagerung). Sep 1987. 52p. (In German). (IFT-TL—47/87). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88752648/JAW.

Personnel monitoring has been carried through in compliance with the Radiation Protection Ordinance. Environmental monitoring including measurement of local doses, local dose rates, and airborne radioactivity in the shaft has been made according to the provisions for radiation protection at the place of work. Maximum permissible personal doses or activity levels for occupationally exposed persons have not been exceeded in the reporting period. Exhaust air monitoring detected the nuclides H-3, C-14, Pb-210, and the short-lived daughter products of Rn-222 and Rn-220. The activity concentrations in the environment, determined from the measured annual release values, for some part have been lower than the average of natural concentrations of said nuclides. The radiation exposure due to emissions, measured at the least favourable point in the environment, has been far below the limits set by the Radiation Protection Ordinance. In conclusion: The radiation exposure of the personnel and of the population in the area of teh Asse shaft plant due to the storage of radioactive low, compared to the natural radiation exposure.

39360 **(GSF-T—250) Geotechnical investigations on backfill materials in the Asse salt mine.** Kappei, G. (Gesellschaft fuer Strahlen- und Umweltforschung m.b.H. Muenchen, Braunschweig (Germany, F.R.). Inst. fuer Tieflagerung). 1987. 35p. (CONF-8609432—). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88754011/JAW.

From US/FRG workshop on sealing and backfilling of a salt repository; Albuquerque, NM, USA (23 Sep 1986).

The compression behaviour of rock salt grit is being investigated by compression tests at the Asse salt mine. The various test parameters are introduced and their results are discussed. The permeability of rock salt grit with saturated NaCl-brine in dependency upon the grain size and compactness, resp. the porosity, is being determined at the Asse salt mine. The test equipment and the results determined here are shown. In addition to laboratory tests, geotechnical investigations are taking place in a carnallitic chamber of the Asse salt mine which had been backfilled in earlier years. They chiefly concern measurements of the deformation rates in drifts - which were mined between the chambers in remaining pillars - as well as horizontal deformation measurements in the backfilling.

39361 **(GSF-T—251) Activities concerning plugging and sealing in the Asse salt mine.** Kappei, G. (Gesellschaft fuer Strahlen- und Umweltforschung m.b.H. Muenchen, Braunschweig (Germany, F.R.). Inst. fuer Tieflagerung). 1986. 13p. (CONF-8609432—). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88753793/JAW.

From US/FRG workshop on sealing and backfilling of a salt repository; Albuquerque, NM, USA (23 Sep 1986).

A large amount of experience regarding chamber sealing has been acquired in the Asse salt mine over the years. Various techniques were tested such as, for example, the pneumatic or pumping technique as well as the possible use of different constructional materials. The schematic construction of several existing bulkheads and the geotechnical instrumentation required for monitoring are described. Results of stress measurements from within a four year's old bulkhead are given. (orig./DG)

39362 **(GSF-T—252) Federal Republic of Germany/backfilling and sealing program - outline.** Kappei, G. (Gesellschaft fuer Strahlen- und Umweltforschung m.b.H. Muenchen, Braunschweig (Germany, F.R.). Inst. fuer Tieflagerung). 1987. 12p. (CONF-8609432—). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88754012/JAW.

From US/FRG workshop on sealing and backfilling of a salt repository; Albuquerque, NM, USA (23 Sep 1986).

After 1978 the Asse salt mine was used exclusively for research work which serves to make available scientific and technical data for the planning, construction and operation of repositories for radioactive wastes. This presentation delineates the advantages of the geological formation rock salt with a view to the final disposal of radioactive wastes subsequent to a short description of the 'Waste Management Concept' of the Federal Republic of Germany. The individual components of the internationally accepted 'Multiple Barrier System' are described, while the technical barriers 'backfilling and sealing' are subject of special consideration. A general formulation of the requirements and objectives of each specific component in the backfilling and sealing system is presented.

39363 (INIS-mf—11195, pp 69-94) **Glass ceramic materials from Spanish basalts.** Martinez Manent, S.; Alonso Abella, P.; La Fuente, C. de; Queralt, I. 1987. NTIS (US Sales Only), PC A10/MF A01. Order Number DE88780093/JAW. (CONF-8505386—).

From Seminar on the use of glasses and glass-ceramics for nuclear waste management; Madrid, Spain (21 May 1985).

In this paper we describe the chemical and mineralogical composition of the Spanish basalt-rocks from Catalonia and Canary Islands like a raw material for the glass-ceramic production. Likewise, the main features of the thermal behaviour of glasses obtained from basalt melts are shown, through their study by means of DTA, XRD, SEM and EDAX techniques. (author) 14 figs., 2 tabs.

39364 (INIS-mf—11195, pp 107-119) **Heat transfer in vitrified radioactive waste.** Palancar, M.C.; Luis, M.A.; Luis, P.; Aragon, J.M.; Montero, M.A. (Universidad Complutense de Madrid (Spain). Dept. Fisicoquimica de Procesos Industriales). 1987. NTIS (US Sales Only), PC A10/MF A01. Order Number DE88780093/JAW. (CONF-8505386—).

From Seminar on the use of glasses and glass-ceramics for nuclear waste management; Madrid, Spain (21 May 1985).

An experimental method for measuring the thermal conductivity and convection coefficient of borosilicate glass cylinders, containing a simulated high level radioactive waste, is described. A simulation of the thermal behaviour of matrices of solidified waste during the cooling in air, water and a geological repository has been done. The experimental values of the thermal conductivity are ranging from 0.267 to 0.591 w/m K, for matrices with simulated waste contents of 10 to 40% (the waste is simulated by no radioactive isotopes). The convection coefficient for air/cylinders under the operating conditions used is 116 w/m/sup 2/K. The simulated operation of cooling in air shows that about 1-2 days are enough to cool a solidified waste cylinder 0.6m diameter from 900 to 400/sup 0/C. The cooling under water from 400 to near 80/sup 0/C is faster than in air, but sharp temperature gradients within the matrices could be expected. The simulation of geological repositories lead to some criteria of arranging the matrices for avoiding undesirable high temperature points. (author) 1 fig.

39365 (INIS-mf—11735) **Direct ultimate disposal of spent fuel elements. Preparatory tests for selection of a suitable packing method. Final report.** Wildt, K.H. (Deutsche Gesellschaft zum Bau und Betrieb von Endlagern fuer Abfallstoffe m.b.H., Peine (Germany, F.R.)). Aug 1987. 101p. (In German). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88754015/JAW.

The pneumatic packing method and the slinger stowing method have been tested under boundary conditions valid for an ultimate disposal site, and have been evaluated quality. Two test series have been made, accompanied by extensive sampling work and analyses of the soil-physical parameters. In-situ ground density measurements have been made with a gamma-gamma probe. Within a given period of observation (2-2 days), no compaction of the material in the roof area could be detected. In the test site packed by the pneumatic method, some wave-shaped cavities of only a few centimetres in depth have been observed at the roof, which are attributed to an unprecise alignment of the pneumatic pipe during packing. Apart from this, the material could be positioned and packed flushing to the roof, also with the slinger method. No cavities could be detected between the containers, or at the bottom sides. Dust suppression through addition of liquids during pneumatic packing is a standard technique and well feasible with the commercially available equipment. As regards the slinger stowing method, there is no established process available yet, but it seems possible to solve the dust problem by means of some technical design modifications at the throwing belt and, where the liquid could be added to the packing material flow so that the dust is sufficiently suppressed.

39366 (IPEN-Pub—117) **Statistical criteria to evaluate homogeneity of radioactive waste forms.** Rzyski, B.M.; Suarez, A.A. (Instituto de Pesquisas Energeticas e Nucleares, Sao Paulo (Brazil)). Aug 1987. 13p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88701633/JAW.

A set of statistical tests is proposed to evaluate the homogeneity of radioactive waste forms. These criteria were applied to cemented waste forms by using natural thorium and uranium compounds as tracers to evaluate the chemical homogeneity of the final product. The mixing technique used to produce the cemented waste forms proved to be good enough as a standard method to obtain a homogeneous product.

39367 (JAERI-M—88-021) **Basic studies on confinement of radionuclides by geological disposal.** Nakamura, Haruto. (Japan Atomic Energy Research Inst., Tokyo). Feb 1988. 16p. (In Japanese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88754108/JAW.

The long-term safety of geological disposal of high-level radioactive waste shall be based on the multi-barrier concept. The confinement of radionuclide will depend on the geological formation of water non-moving zone in deep underground. Researches on confinement of nuclides in the geological formation, especially on mineralization, in JAERI are described. Main items are; deposition in altered surface layer of vitrified waste form after leaching, nuclides migration in rock, diffusion and deposition into rock matrix around fracture zone and deposition on reducing materials in sediment of seabed.

39368 (JAERI-M—88-025) **Experiment to evaluate integrity of high-level waste canister in the high-pressure water tank.** Suzuki, Takatsugu; Muraoka, Susumu; Nakamura, Haruto. (Japan Atomic Energy Research Inst., Tokyo). Feb 1988. 30p. (In Japanese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88754112/JAW.

The effect of external static pressure on the high-level waste canister has been examined by using the high-pressure water tank. The purpose of this test is to evaluate the integrity of a canister throughout the canister handling and disposal. In this test, the deformation of simulated high-level waste canister was observed by increasing gradually the hydraulic pressure. The tested canister was made of Type 304 stainless steel with a diameter of 40 cm and a length of 133.5 cm. In the canister, the concreet was filled to simulate the vitrified waste. The canister was provided with 16 strain gages on its outer surface in order to measure strain changes due to the pressure increase. The result shows that the plenum of tested canister yielded to hydraulic pressure between 0.37 MPa and 1.46 MPa. It is confirmed that the plenum is the most weak part of the canister and it is possible to occur the residual stress which causes stress corrosion cracking (SCC). The plenum should be considered to be protected to prevent the occurrence of SCC.

39369 (JAERI-M—88-027) **High hydrostatic pressure tests of the unsaturated polyester products.** Sano, Fumiaki; Dojiri, Shigeru; Ouchi, Kouki; Okagawa, Seigo; Moriyama, Noboru; Ito, Akihiko. (Japan Atomic Energy Research Inst., Tokyo). Feb 1988. 61p. (In Japanese). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88754114/JAW.

For the purpose of evaluating the adaptability of the unsaturated polyester products to sea disposal, the leaching of radionuclides and integrity testes were carried out under high hydrostatic pressure. These testes were carried out for about a month under the conditions simulating hydrostatic pressure (500 +- 5 kg/cm/sup 2/), temperature (2 +- 0.5 deg C) and flow rate (1.1 cm/sec) on the sea bed of 5,000 m depth level. The test results indicated that these products kept the integrity under the above-mentioned conditions and that they had a low leachability. Therefore, it is concluded that these products were adaptable enough to sea disposal without losing their high volume reduction property compared with cement solidified wastes.

39370 (JAERI-M—88-028) **Development of partitioning method. Back-extraction behavior of actinides in DIDPA solvent.** Kubota, Kazuo; Morita, Yasuji; Kubota, Masumitsu. (Japan Atomic Energy Research Inst., Tokyo). Feb 1988. 39p. (In Japanese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88754115/JAW.

A partitioning method has been developed under the concepts of separation of nuclides in high level nuclear fuel reprocess-

ing liquid waste according to their half lives and radioactive toxicity and of disposal of them by suitable methods. In the partitioning process, which has been developed in JAERI, adoption of solvent extraction process with DIDPA (di-isodecyl phosphoric acid) has been studied for actinides separation. The present paper mainly describes studies on back extraction behavior of Np(IV), Pu(IV) and U(VI) in DIDPA. Most experiments were carried out according to following procedure. These actinides were extracted from 0.5 M nitric acid with DIDPA, where nitric acid concentration in HLW is expected to be adjusted to this value prior to actinides extraction in the partitioning process, and back-extracted with various reagents such as oxalic acid. The experimental results show that distribution ratios of Np(IV) and Pu(IV) can be reduced to less than unity with 1 M oxalic acid and those of U(VI) and Np(IV) with 5 M phosphoric acid. From results of these studies and previous research on Am and Cm, following possibilities were confirmed ; U, Pu, Np, Am and Cm, which are major actinides in HLW, can be extracted simultaneously with DIDPA, and they can be removed from DIDPA with various reagents. (nitric acid for Am and Cm, oxalic acid for Np and Pu, and phosphoric acid for U respectively).

39371 **(K/ITP—175) Safeguards and the US Waste Management Program.** Moran, B.W.; Fishbone, L.G.; Johnson, E.R.; Saling, J.H.; Wonder, E.F. (Oak Ridge Gaseous Diffusion Plant, TN (USA)). 1988. Contract AC05-84OR21400. 5p. (CONF-880631—18). NTIS, PC A02/MF A01;1; GPO Dep. Order Number DE88012558/JAW.

From 29. annual meeting of the Institute of Nuclear Materials Management; Las Vegas, NV, USA (26 Jun 1988).

Recommended activities to initiate the cost-effective implementation of nuclear materials safeguards in the US Federal Waste Management System are described. Requirements for the safeguarding of spent nuclear fuel and high-level radioactive wastes in transport operations, dry storage, fuel repackaging, and final disposal in a mined geologic repository are evaluated. Operated by the US Department of Energy's Office of Civilian Radioactive Waste Management, licensed by the US Nuclear Regulatory Commission, and eligible for International Atomic Energy Agency safeguards, the Federal Waste Management System will most likely be required to meet the directives of each safeguards authority. Recommended activities include a review of the effectiveness of existing requirements for safeguarding the spent nuclear fuel and high-level radioactive wastes associated with the Federal Waste Management System, the development of pro forma safeguards plans, the evaluation of methods for the determination of the special nuclear material content of the wastes, and the assessment of potentially applicable containment and surveillance techniques. 1 ref.

39372 **(LA-UR—88-1570) International safeguards concerns of Spent Fuel Disposal Program.** Pillay, K.K.S. (Los Alamos National Lab., NM (USA)). 1988. Contract W-7405-ENG-36. 6p. (CONF-880631—4). NTIS, PC A02/MF A01;1; GPO Dep. Order Number DE88010925/JAW.

From 29. annual meeting of the Institute of Nuclear Materials Management; Las Vegas, NV, USA (26 Jun 1988).

The purpose of this paper is to stimulate discussions on the subjects of safeguarding large quantities of plutonium contained in spent fuels to be disposed of in geologic respositories. All the spent fuel disposal scenarios examined here pose a variety of safeguards problems, none of which are adequately addressed by the international safeguards community. The spent fuels from once-through fuel cycles in underground repositories would become an increasingly attractive target for diversion because of their plutonium content and decreasing radioactivity. Current design of the first geologic repository in the US will have the capacity to accommodate wastes equivalent to 70,000 Mt of uranium from commercial and defense fuel cycles. Of this, approximately 62,000 Mt uranium equivalent will be commerical spent fuel, containing over 500 Mt of plutonium. International safeguards commitments may require us to address the safeguards issues of disposing of such large quanities of plutonium in a geologic repository, which has the potential to become a plutonium mine in the future. This paper highlights several issues that should be addressed in the near term by US industries and the DOE before geologic repositories for spent fuels become a reality.

39373 **(MLM—3508(OP)) Physical inventory by use of modeling for the tritium aqueous waste recovery system.** Sienkiewicz, C.J.; Lentz, J.E.; Wiggins, D.V. (Monsanto Research Corp., Miamisburg, OH (USA). Mound). 1988. Contract AC04-76DP00053. 6p. (CONF-880505—34). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88012878/JAW.

From 3. topical meeting on tritium technology in fission, fusion and isotopic applications; Toronto, Canada (1 May 1988).

Physical inventory requirements for the Tritium Aqueous Waste Recovery System (TAWRS) presented constraints that required unique solutions. Available analytical techniques for which sound measurement control practices existed could not be readily adapted to the system without significant modifications and expense. Based on the assumption that would accurately estimate total system inventory given a few key measurements, a model was developed for TAWRS. Tritium concentrations in two streams, the tritiated feed stream to the process and the tritiated hydrogen stream generated by the electrolysis cells, provided the key values to the model. The proposed mathematical model relates the tritium concentration throughout the system to the tritium concentration in these two streams. Testing of the system using low-level tritiated feed water was conducted to characterize tritium distribution in the system and to relate key values to total inventory. 4 refs., 2 figs.,

39374 **(NSS/R—104) Experimental and modelling studies of the near-field chemistry for Nirex repository concepts.** Atkinson, A.; Ewart, F.T.; Pugh, S.Y.R.; Rees, J.H.; Sharland, S.M.; Tasker, P.W.; Wilkins, J.D. (United Kingdom Nirex, Ltd.). Feb 1988. 14p. (CONF-8711200—). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88753993/JAW.

From NEA workshop on near-field assessments for repositories; Baden, Switzerland (23 Nov 1987).

A research programme is described which is designed to investigate the chemical conditions in the near field of a concrete based repository and the behaviour of the radiologically important nuclides under these conditions. The chemical conditions are determined by the corrosion of the iron components of the repository and by the soluble components of the concrete. Both of these have been investigated experimentally and models developed which have been validated by further experiment. The effect of these reactions on the repository pH and Eh, and how these develop in time and space have been modelled using a coupled chemical equilibrium and transport code. The solubility of the important nuclides are being studied experimentally under these conditions, and under sensible variations. These data have been used to refine the thermodynamic data base used for the geochemical code PHREEQE. The sorption behaviour of plutonium and americium, under the same conditions, have been studied; the sorption coefficients were found to be large and independent of the concrete formulation, particle size and solid liquid ratio. Recent experimental results from sorption/exchange experiments with lead and 14-carbon are also reported. The programme has also investigated experimentally the possible perturbation of the repository chemistry by microbial action and by natural and added organic material. A final set of experiments combine all the repository components and the waste in a long term equilibration experiment.

39375 **(NSS/R—110) Laboratory measurements of the solute transport properties of samples from the Bradwell, Elstow, Fulbeck and Killingholme site investigations .** Gilling, D.; Jefferies, N.L.; Lineham, T.R. (United Kingdom Nirex, Ltd.; UKAEA Harwell Lab. Chemistry Div.). Dec 1987. 57p. (AERE-R—12884). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88753996/JAW.

The diffusivity and hydraulic conductivity of geological samples collected during the site investigations at Bradwell, Elstow, Fulbeck and Killingholme have been determined. Comparison between laboratory permeability measurements and in-situ permeability measurements for the mudstone units may give some indication of the importance of fissure flow at the sites.

39376 **(NUREG/CR—5129) Experimental assessment of the influence of dynamic loading on the permeability of wet and of dried cement borehole seals.** Adisoma, G.; Daemen, J.J.K. (Arizona Univ., Tucson (USA). Dept. of Mining and Geological Engineering). Apr 1988. 277p. NTIS, PC A13/MF A01 - GPO;1. Order Number TI88009565/JAW.

An experimental sealing performance assessment of cement borehole plugs that have been subjected to dynamic loading is provided. This includes a study of plugs that have dried, as well as of plugs that have remained wet throughout the testing period. An introductory literature review indicates that deep underground structures in competent rock are safer than surface structures, openings at shallow depth, and openings in fractured rocks, when subjected to earthquakes and subsurface blasts. Cement plugs are installed in 2.5 cm diameter coaxial holes in 15 cm diameter granite cylinders. Water is injected under pressure on top of the plugs and is collected below the plugs. Hydraulic conductivities are calculated from the measured flowrates. Once a long-term steady-state flow trend has been established, the samples are subjected to dynamic loading on a shaking table. Flow tests show that wet cement seals are less permeable than intact Charcoal granite. Sealing performance can degrade severely when cement seals are allowed to dry. Dye injection shows very limited and uniform penetration into wet plugs, but strongly preferential flow along the plug/rock interface of dried plugs. The permeability of wet and of rewetted previously dried cement seals does not change significantly after the application of dynamic loads. Sealing in an unsaturated environment may affect the drying (curing, aging) conditions of cementitious seals, as well as the structure of earthen seals. An saturated environment will need to be integrated realistically into sealing performance tests and analyses. 263 refs., 73 figs., 5 tabs.

39377 **(ORNL—6482) RCRIS [Resource Conservation and Recovery Information System] compliance monitoring and enforcement functional specification for the implementation module.** Ng, V. (Oak Ridge National Lab., TN (USA)). May 1988. Contract AC05-84OR21400. 312p. NTIS, PC A14/MF A01; 1; GPO Dep. Order Number DE88013342/JAW.

Under a US Department of Energy interagency agreement with the US Environmental Protection Agency (USEPA), Oak Ridge National Laboratory was tasked to design and develop prototypes for the Resource Conservation and Recovery Information System (RCRIS). RCRIS is a distributed information system designed to aid USEPA and states to regulate the generation, transportation, treatment, storage and disposal of hazardous wastes. RCRIS was to be implemented as eleven work packages. One of the core user requirements is to design and prototype an automated event tracking application for the compliance monitoring and enforcement program. This document contains the functional specification for the compliance monitoring and enforcement application for the program implementors. The design outlined in this document is the outcome of nine months of prototyping effort. It has been proved to effectively satisfy user needs. 11 figs.

39378 **(ORNL/TM—10802) Disposal of remotely handled transuranic waste from Oak Ridge National Laboratory: A strategy for NEPA [National Environmental Policy Act of 1969] compliance.** Campbell, A.W. (Oak Ridge National Lab., TN (USA)). Jun 1988. Contract AC05-84OR21400. 31p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88013511/JAW.

Transuranic (TRU) radioactive waste contains alpha-emitting radionuclides with atomic numbers greater that 92 and half-lives greater than 20 years. The US Department of Energy's (DOE) transuranic waste results from defense-related research and production activities. Prior to 1970, DOE disposed of TRU waste by shallow land burial. Because of environmental concerns, disposal policy was changed, and since 1970, all of DOE's TRU waste has been placed in retrievable storage at DOE facilities. Future disposal plans call for deep geological isolation of all TRU waste at the DOE Waste Isolation Pilot Plant (WIPP) near Carlsbad, New Mexico. The Oak Ridge National Laboratory (ORNL) will construct and operate the Waste Handling and Packing Plant (WHPP) to assay package, and certify remotely handled (RH) TRU waste prior to shipment for disposal at the WIPP. To assist the ORNL TRU Waste Program in planning for a new remotely handled transuranic WHPP facility, feasible options for achieving compliance with the National Environmental Policy Act of 1969 (NEPA) were identified and analyzed with regard to implementation. The feasible options for achieving compliance with NEPA were limited to documentation in the form of an Environmental Assessment (EA) or an Environmental Impact Statement (EIS). An analysis of time and cost constraints and consideration of potential evnironmental issues from construction and operation of the WHPP indicated that preparation of an EA would likely be the best strategy. 10 refs., 8 figs., 5 tabs.

39379 **(PNL—6382) Understanding socioeconomic aspects of risk perception: Progress report, FY-1987: Working draft.** Liebow, E.B.; Fawcett-Long, J.A.; Terrill, E.S. (Pacific Northwest Lab., Richland, WA (USA)). Nov 1987. Contract AC06-76RL01830. 89p. (BHARC—800/87/023). NTIS, PC A05/MF A01;1; GPO Dep. Order Number DE88007990/JAW.

This report summarizes progress to date in understanding the issue of risk perception and its implications for the suitability of the Hanford Site in eastern Washington as a location for an underground radioactive waste repository. It presents some observations about the causes, consequences and processes of risk perception gained from a review of the professional literature. It also contains an extensive working bibliography of useful reference materials, and a compilation of abstracts from selected articles that are felt to be of particular relevance to the BWIP licensing and institutional support efforts. 293 refs.

39380 **(PNL—6386) Socioeconomic conditions in cultural communities: The Nez Perce Tribe, the confederated Tribes of the Umatilla Indian Reservation and the confederated tribes and bands of the Yakima Indian Nation: Interim profile report.** Stokowski, P.A.; Friedli, E.A. (Battelle Human Affairs Research Centers, Washington, DC (USA)). Nov 1987. Contract AC06-76RL01830. 42p. (BHARC—800/87/021). NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88007989/JAW.

A series of BWIP Socioeconomic Profile Reports are being prepared. This report is one of the first set of five separate BWIP Profile Reports, which cover: economic/demographic conditions; fiscal conditions; housing characteristics; public services and facilities; and socioeconomic conditions in cultural communities. The BWIP Socioeconomic Profile Reports are designed to provide information about the characteristics of the communities in which socioeconomic impacts from BWIP may occur. The Profile Reports present a compilation of historical information about socioeconomic conditions in the affected communities. These reports are designed to provide a transition between the BWIP EA, published in 1986, the Monitoring Reports, and other technical reports associated with the BWIP SMMP and CSP. The principal objectives of the Profile Reports are to update the DOE BWIP socioeconomic database by compiling available secondary and primary data and to make this information available to both the DOE program and other interested parties. The initial Profile Reports will help identify the need for additional data. The database developed for the profiles will assemble socioeconomic data in a uniform, readily accessible format. 16 refs., 1 fig., 17 tabs.

39381 **(PNL—6474) Application of the TEMPEST computer code to canister-filling heat transfer problems.** Farnsworth, R.K.; Faletti, D.W.; Budden, M.J. (Pacific Northwest Lab., Richland, WA (USA)). Mar 1988. Contract AC06-76RL01830. 175p. NTIS, PC A08/MF A01; GPO Dep. Order Number DE88008072/JAW.

Pacific Northwest Laboratory (PNL) researchers used the TEMPEST computer code to simulate thermal cooldown behavior of nuclear waste glass after it was poured into steel canisters for long-term storage. The objective of this work was to determine the accuracy and applicability of the TEMPEST code when used to compute canister thermal histories. First, experimental data were obtained to provide the basis for comparing TEMPEST-generated predictions. Five canisters were instrumented with appropriately located radial and axial thermocouples. The canister were filled using

the pilot-scale ceramic melter (PSCM) at PNL. Each canister was filled in either a continous or a batch filling mode. One of the canisters was also filled within a turntable-simulant (a group of cylindrical shells with heat transfer resistances similar to those in an actual melter turntable). This was necessary to provide a basis for assessing the ability of the TEMPEST code to also model the transient cooling of canisters in a melter turntable. The continous-fill model, Version M, was found to predict temperatures with more accuracy. The turntable simulant experiment demonstrated that TEMPEST can adequately model the asymmetric temperature field caused by the turntable geometry. Further, TEMPEST can acceptably predict the canister cooling history within a turntable, despite code limitations in computing simultaneous radiation and convection heat transfer between shells, along with uncertainty in stainless-steel surface emissivities. Based on the successful performance of TEMPEST Version M, development was initiated to incorporate 1) full viscous glass convection, 2) a dynamically adaptive grid that automatically follows the glass/air interface throughout the transient, and 3) a full enclosure radiation model to allow radiation heat transfer to non-nearest neighbor cells. 5 refs., 47 figs., 17 tabs.

39382 (PNL—6515) Assessing social and economic effects of perceived risk: Workshop summary: Draft: BWIP Repository Project. Nealey, S.M.; Liebow, E.B. (eds.). (Battelle Human Affairs Research Center, Seattle, WA (USA)). Mar 1988. Contract AC06-76RL01830. 38p. (BHARC—800/88/005). NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88010589/JAW.

The US Department of Energy sponsored a one-day workshop to discuss the complex dimensions of risk judgment formation and the assessment of social and economic effects of risk perceptions related to the permanent underground storage of highly radioactive waste from commercial nuclear power plants. Affected parties have publicly expressed concerns about potentially significant risk-related effects of this approach to waste management. A selective review of relevant literature in psychology, decision analysis, economics, sociology, and anthropology was completed, along with an examination of decision analysis techniques that might assist in developing suitable responses to public risk-related concerns. The workshop was organized as a forum in which a set of distinguished experts could exchange ideas and observations about the problems of characterizing the effects of risk judgments. Out of the exchange emerged the issues or themes of problems with probabilistic risk assessment techniques are evident; differences exist in the way experts and laypersons view risk, and this leads to higher levels of public concern than experts feel are justified; experts, risk managers, and decision-makers sometimes err in assessing risk and in dealing with the public; credibility and trust are important contributing factors in the formation of risk judgments; social and economic consequences of perceived risk should be properly anticipated; improvements can be made in informing the public about risk; the role of the public in risk assessment, risk management and decisions about risk should be reconsidered; and mitigation and compensation are central to resolving conflicts arising from divergent risk judgments. 1 tab.

39383 (PNL—6530) Process performance of the pilot-scale in situ vitrification of a simulated waste disposal site at the Oak Ridge National Laboratory. Carter, J.G.; Koegler, S.S.; Bates, S.O. (Pacific Northwest Lab., Richland, WA (USA)). Jun 1988. Contract AC06-76RL01830. 144p. NTIS, PC A07/MF A01;1; GPO Dep. Order Number DE88012511/JAW.

Process feasibility studies have been successfully performed on three developmental scales to determine the potential for applying in situ vitrification to intermediate-level (low-level) waste placed in seepage pits and trenches at Oak Ridge National Laboratory (ORNL). In the laboratory, testing was performed in crucibles containing a mixture of 50% ORNL soil and 50% limestone. In an engineering-scale test at Pacific Northwest Laboratory a {1/12}-scale simulation of an ORNL waste trench was constructed and vitrified, resulting in a waste product containing soil and limestone concentrations of 68 wt % and 32 wt %, respectively. In the pilot-scale test a {3/8}-scale simulation of the same trench was constructed and vitrified at ORNL, resulting in soil and limestone concentrations of 80% and 20%, respectively, in the waste product. Results of the three scales of testing indicate that the ORNL intermediate-level (low-level) waste sites can be successfully processed by in situ vitrification; the waste form will retain significant quantities of the cesium and strontium. Because cesium-137 and strontium-90 are the major components of the radionuclide inventory in the ORNL seepage pits and trenches, final field process decontamination factors (i.e., losses to the off-gas system relative to the waste inventory) of 1.0 E + 4 are desired to minimize activity buildup in the off-gas system. 17 refs., 34 figs., 13 tabs.

39384 (PNL—6532) FY-87 packing fabrication techniques (commercial waste form) results. Werry, E.V.; Gates, T.E.; Cabbage, K.S.; Eklund, J.D. (Pacific Northwest Lab., Richland, WA (USA)). Apr 1988. Contract AC06-76RL01830. 95p. NTIS, PC A05/MF A01. Order Number DE88008461/JAW.

This report covers the investigation of fabrication techniques associated with the development of suitable materials and methods to provide a prefabricated packing for waste packages for the Basalt Waste Isolation Project (BWIP). The principal functions of the packing are to minimize container corrosion during the 300 to 1000 years following repository closure and provide long-term control of the release of radionuclides from the waste package. The investigative work, discussed in this report, was specifically conceived to develop the design criteria for production of full-scale prototypical packing rings. The investigative work included the preparation of procedures, the preparation of fabrication materials, physical properties, and the determination of the engineering properties. The principal activities were the preparation of the materials and the determination of the physical properties. 21 refs., 20 figs., 14 tabs.

39385 (PNL—6567) Development of a chemical process using nitric acid-cerium(IV) for decontamination of high-level waste canisters. Bray, L.A. (Pacific Northwest Lab., Richland, WA (USA)). Jun 1988. Contract AC06-76RL01830. 52p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE88013137/JAW.

A simple and effective method was developed for contamination of high-level waste containers. This method of chemical decontamination is applicable to a wide variety of contaminated equipment found in the nuclear industry. The process employs a oxidant system [Ce(IV)] in nitric acid (HNO_3) solution to chemically mill a thin layer from the canister surface. Contaminated canisters are simply immersed in the solution at a controlled temperature and Ce(IV) concentration level. The spent solution is discarded to the high-level waste stream and added to subsequent glass batches. The Ce(IV)/HNO_3 solution has been shown to be effective in chemically milling the surface of stainless steel, similar to the electropolishing process, but without the need for an applied electrical current. West Valley (WV) staff had previously evaluated several canister decontamination methods, including electropolishing, liquid abrasive blast, high-pressure water wash, and ultrasonic cleaning, before the Ce(IV)/HNO_3 redox solution on treatment was selected. The initial concept involved continuous electrochemical regeneration of the ceric ion. Extensive in-cell pumping and close-coupled heat transfer and electrochemical equipment were required. The objective of this study, was to simplify the original concept. 2 refs., 16 figs., 4 tabs.

39386 (PNL/SRP—6389) Defense Waste Glass Studies Program: FY 1986 annual report: Salt repository project. McGrail, B.P.; Reimus, M.A. (Pacific Northwest Lab., Richland, WA (USA)). Dec 1987. Contract AC06-76RL01830. 38p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88010242/JAW.

DWGS is developing the necessary data and models to predict the radionuclide release behavior of defense waste glasses in a salt repository environment. In FY 1986, contributions toward achieving this goal were made under the following four subtasks: static testing; flow testing; colloid studies; and modeling. Static leach tests were performed with Savannah River Laboratory defense waste glass (SRL-165) in a high-magnesium salt brine (PBB3) at a temperature of 90{degree}C. The flow testing subtask was formed in FY 1986. A leach test procedure was developed, 'Flow-Through Waste Glass Testing,' which may be used in future work to study glass leaching mechanisms. Objective of the colloid studies

subtask is to develop a submodel describing radionuclide release associated with colloids, provided such a submodel is needed. Under the modeling subtask, a simple glass dissolution model was formulated that balances the consumption and production of silicic acid to control the rate of glass dissolution. A more comprehensive model is under preparation. 23 refs., 10 figs., 4 tabs.

39387 **(PNL/SRP-SA—15684) Corrosion and hydrogen permeation of A216 Grade WCA steel in hydrothermal magnesium-containing brines.** Haberman, J.H.; Frydrych, D.J.; Westerman, R.E. (Pacific Northwest Lab., Richland, WA (USA)). Mar 1988. Contract AC06-76RL01830. 25p. (CONF-880377—1). NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88008175/JAW.

From Joint U.S. DOE/FRG workshop on nuclear package materials; Albuquerque, NM, USA (9 Mar 1988).

Corrosion rates determined at 1 month in 150{degree}C brine increased with magnesium concentration. The structure of the corrosion product, as determined by x-ray diffraction, depended upon the magnesium concentration. In brines with less than 10,000 ppM magnesium, the primary corrosion product had a spinel structure characteristic of magnetite or magnesioferrite. In brines containing magnesium concentrations greater than 20,000 ppM, the primary corrosion product had the amakinite structure characteristic of a complex iron-magnesium hydroxide. The high corrosion rates observed in brines containing high magnesium concentrations suggest that the corrosion products having the amakinite structure is less protective than corrosion products having the spinel structure. Corrosion rates in high-magnesium (inclusion) brine determined over a 6-month test duration were essentially constant. Hydrogen permeation rates observed in exposing mild steel to high-Mg/sup 2{plus/} brine at 150{degree}C could be potentially damaging to a mild steel waste package container. The rate of hydrogen permeation was proportional to the brine flow rate in the autoclave. Thiourea additions to the brine increased the hydrogen permeation rate; sulfate and bromide ion additions did not. The maximum gaseous hydrogen pressure attainable is not known (based on 3Fe {plus} $4H_3O$ {plus} Fe(sub 3)O {plus} $4H_2$, would be {approximately}900 atmospheres), and the dependence of permeation rate on temperature is not known. 8 refs., 13 figs., 3 tabs.

39388 **(SAND—86-1471) Preliminary geologic and waste package sensitivity study for subseabed high-level nuclear waste disposal.** Klett, R.D.; Hertel, E.S. Jr. (Sandia National Labs., Albuquerque, NM (USA)). Jan 1988. Contract AC04-76DP00789. 135p. NTIS, PC A07/MF A01;1; GPO Dep. Order Number DE88013157/JAW.

Preliminary thermal and nuclide transport sensitivity studies of the waste package and sediments were conducted for the Subseabed Nuclear Waste Disposal Project. These studies quantified criteria, provided guidance for research, and were inputs to risk assessments and to the design of the reference system for the feasibility phase of the project. Heat transfer sensitivity was analyzed over a wide range of site properties and repository and waste package design parameters. Parameter groups in the nuclide transport studies included waste package containment, sediment properties, site characteristics, and repository designs. Time-integrated world population doses and peak individual dose rates were used as the evaluation standards. 27 refs., 62 figs., 40 tabs.

39389 **(SAND—87-1176-Vol.3) Description of ground motion data processing codes: Volume 3.** Sanders, M.L. (Sandia National Labs., Albuquerque, NM (USA)). Feb 1988. Contract AC04-76DP00789. 182p. NTIS, PC A09/MF A01;1; GPO Dep. Order Number TI88005816/JAW.

Data processing codes developed to process ground motion at the Nevada Test Site for the Weapons Test Seismic Investigations Project are used today as part of the program to process ground motion records for the Nevada Nuclear Waste Storage Investigations Project. The work contained in this report documents and lists codes and verifies the "PSRV" code. 39 figs.

39390 **(SAND—87-2456) Interpretation of the WIPP-13 multipad pumping test of the Culebra Dolomite at the Waste Isolation Pilot Plant (WIPP) site.** Beauheim, R.L. (Sandia National Labs., Albuquerque, NM (USA)). Dec 1987. Contract AC04-76DP00789. 165p. NTIS, PC A08/MF A01;1; GPO Dep. Order Number DE88013155/JAW.

A large-scale pumping test of the Culebra Dolomite Member of the Rustler Formation was performed in early 1987 at the Waste Isolation Pilot Plant (WIPP) site in southeastern New Mexico. This test complemented the H-3 (or southern) multipad test by creating a hydraulic stress that could be measured over the northern portion of the WIPP site. The test consisted of pumping well WIPP-13 at a rate of 30 gpm for 36 days and monitoring drawdown and recovery responses in 17 observation wells and one WIPP shaft. Responses were observed in 14 of these wells. Interpretations of the responses at the wells are consistent with the following conceptualization: The Culebra is a fractured, double-porosity system around WIPP-13, H-6, and DOE-2, with relatively high transmissivity and relatively low storativity. The analyses of the responses measured at observation wells to the WIPP-13 multipad pumping test provide a qualitative conceptualization of three distinct domains within a heterogeneous portion of the Culebra north of the center of the WIPP site. This conceptualization is being refined by using numerical-modeling techniques to simulate the WIPP-13 multipad test and other tests at the WIPP site in an attempt to define the distribution of hydraulic properties that will reproduce the responses observed. 36 refs., 74 figs., 3 tabs.

39391 **(SAND—87-2804) WIPP [Waste Isolation Pilot Plant] panel entryway seal: Numerical simulation of seal composite interaction for preliminary design evaluation.** Argueello, J.G. (Sandia National Labs., Albuquerque, NM (USA)). Apr 1988. Contract AC04-76DP00789. 57p. NTIS, PC A04/MF A01;1; GPO Dep. Order Number DE88008741/JAW.

This report presents the results of a series of structural analyses performed to evaluate the structural interaction of the components of a potential two-component panel entryway seal configuration with each other and with the rock salt formation at the repository horizon of the Waste Isolation Pilot Plant. A two-dimensional axisymmetric geomechanical model is used to numerically simulate the interaction of the components of a 30.48 m (100 ft) long seal, consisting of concrete end caps and a crushed salt core, with each other and with the surrounding formation. Issues addressed in this report pertain to the consolidation of the crushed salt in terms of how much of the seal core reaches effective consolidation in the presence of the stiff concrete end caps since these could conceivably cause bridging (retardation of closure around the core) to occur. In addition, the stress field in the end caps is evaluated to determine if the concrete component maintains its integrity. The stresses induced in the surrounding formation are also evaluated to determine if the presence of the concrete component in the seal system results in a "tightening" of the formation around the seal. 20 refs., 43 figs., 2 tabs.

39392 **(SAND—87-7166) WIPP hydrology program, Waste Isolation Pilot Plant, southeastern New Mexico: Hydrologic data report No. 6: Part A, Waste-handling shaft pulse testing; Part B, H-1, H-12, and P-15 slug tests; Part C, H-2 pumping test; Part D, H-16, H-17, and H-18 drill-stem, slug, and pulse tests; Part E, Water-level data.** Stensrud, W.A.; Bame, M.A.; Lantz, K.D.; Cauffman, T.L.; Palmer, J.B.; Saulnier, G.J. Jr. (Sandia National Labs., Albuquerque, NM (USA); Intera Technologies, Inc., Austin, TX (USA)). 12 May 1988. Contract AC04-76DP00789. 710p. NTIS, PC A99/MF A01;1; GPO Dep. Order Number DE88013135/JAW.

This report contains data from hydrologic testing and water-level measurements conductd at the Waste Isolation Pilot Plant (WIPP) site over the period May through October 1987. These report disseminate basic hydrologic data to interested parties in a timely manner, often before data interpretation has been performed. Hydrologic Data Report #6 contains descriptions of: permeability tests conducted from July to August 1987 in six sub-horizontal boreholes drilled from the waste-handling shaft (Part A); well develop-

ment and slug testing conductd at wells H-1, H-12, and P-15 (Part B); a pumping test performed from July to September 1987 in conjunction with water-quality sampling at the H-2 hydropad (Part C); and drill-stem, slug, and pulse testing conducted by Sandia at wells H-16, H-17, and H-18 (Part D). Part E has been produced by INTERA from water-level and fluid-pressure data collected by INTERA and Sandia from May to October 1987. 5 refs., 136 figs., 100 tabs.

39393 **(SAND—88-0157) Summary of site-characterization studies conducted from 1983 through 1987 at the Waste Isolation Pilot Plant (WIPP) site, southeastern New Mexico.** Lappin, A.R. (Sandia National Labs., Albuquerque, NM (USA)). May 1988. Contract AC04-76DP00789. 274p. NTIS, PC A13/MF A01; 1; GPO Dep. Order Number DE88013140/JAW.

The Waste Isolation Pilot Plant (WIPP) is being constructed at a depth of 650 m in bedded halites of the Salado Formation. The geologic setting of the WIPP site has been active for at least 250 million years, and is presently responding to the end of the last pluvial period, within the 10,000-year time scale of regulatory interest. Both construction of the WIPP facility and WIPP site-characterization activities impose additional transient effects, some of which will last until hydrologic and structural closure of the facility. The Bell Canyon Formation beneath the WIPP facility contains shales, siltstones, and sandstones. Studies suggest that no channel sandstone is present in the Bell Canyon beneath the WIPP site. Fluid movement would be downward if drilling interconnected the Bell Canyon with the Rustler Formation, the first water-bearing zone above the WIPP facility. The Salado and Castile Formations contain abundant bedded halites and anhydrites, and deform in response to gravity. Fluids play a major role in this deformation, although the regional permeabilities of both units are extremely low. Pressurized brines may be present within the Castile Formation 200 m or more beneath the WIPP waste-emplacement panels. The hydrologic and structural characteristics of the Salado change within an altered zone extending a few meters from the WIPP underground workings. 124 refs., 91 figs., 22 tabs.

39394 **(SAND—88-0616) Numerical and analytical methods for approximating the eccentric impact response (slapdown) of deformable bodies.** Sjaardema, G.D.; Wellman, G.W. (Sandia National Labs., Albuquerque, NM (USA)). Mar 1988. Contract AC04-76DP00789. 73p. NTIS, PC A04/MF A01. Order Number DE88010369/JAW.

Analytical and numerical methods have been developed to approximate the eccentric impact response of deformable bodies. The eccentric impact response is commonly known as slapdown since the off-center impact gives the body a rotational velocity which causes impact at the opposite end. A code, SLAPDOWN, has been written to approximate the slapdown behavior of deformable bodies. The body is idealized as a three degree-of-freedom system with nonlinear impact behavior. Several parameters of interest to the analysis of radioactive transporation containers were studied to determine their effects on the secondary impact velocities (slapdown). Parameters studied are aspect ratio of the body, stiffness of the initial impact and friction between the target and the body. Rules for applying the results of scale model tests to full scale bodies are developed and confirmed for nonlinear spring behavior. 5 refs., 32 figs., 18 tabs.

39395 **(SKB-TR—87-08) Approach for evaluating the general and localised corrosion of carbon steel containers for nuclear waste disposal.** Marsh, G.P.; Taylor, K.J.; Sharland, S.M.; Tasker, P.W. (Swedish Nuclear Fuel and Waste Management Co., Stockholm; UKAEA Atomic Energy Research Establishment, Harwell. Materials Development Div.; UKAEA Atomic Energy Research Establishment, Harwell. Theoretical Physics Div.). Jun 1987. 14p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88752716/JAW.

The paper considers the long term corrosion of carbon steel containers for heat gener.ting nuclear waste in a granitic repository. Under such conditions carbon steel may exhibit general, localised or passive corrosion behaviour depending on the exact composition and redox potential of the groundwater contacting the containers; localised corrosion being of most concern because it has the fastest propagation rate. It is well established, however, that such localised corrosion is only possible when the environment is sufficiently oxidising to maintain a positive potential gradient between the cathodic surface and the corrosion sites, which requires that species which oxidising potentials greater than water need to be present. This fact provides a basis for estimating the periods during which containers may be subject to localised and subsequently to general corrosion, and hence for making an overall assessment of the metal allowance required for a specified container life. A model for the diffusion transport of oxygen has been developed, and a sensitivity analysis has shown that the period of possible attack is strongly dependent on the passive film leakage current, the radiation dose rate and the oxygen diffusion coefficient.

39396 **(SKB-TR—87-24) Geological maps and cross-sections of southern Sweden.** Kornfaelt, K.A.; Larsson, K. (Sveriges Geologiska Undersoekning, Lund; Softrock Consulting, Genarp (Sweden)). (Swedish Nuclear Fuel and Waste Management Co., Stockholm). Dec 1987. 94p. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88754188/JAW.

The report is meant to give complementary information to the maps of precambrian and sedimentary rocks, which have been compiled by the Geological Survey of Sweden (SGU), by order of the Swedish Nuclear Fuel and Waste Management Co. (SKB) and South Sweden Power Supply (SK). The local branch of the Geological Survey in Goeteborg has compiled the maps of the bedrock Goeteborg and Boras. The purpose of the work was to compile maps of the bedrock to the scale of 1:250000 as well as to the scale of 1:1000000, covering an area corresponding to the mapsheets to the scale of 1:250000: Goeteborg, Boraas, Joenkoeping, Oskarshamn, Malmoe, Karlskrona and Kalmar. Also lineament maps to the scale of 1:250000, covering the same area, have been compiled.

39397 **(STRIPA-TR—87-16) Crosshole investigations. Final report.** Olsson, O.; Black, J.; Cosma, C.; Pihl, J. (Sveriges Geologiska Undersoekning, Uppsala; British Geological Survey, Keyworth; Vibrometric Oy, Helsinki (Finland); Foersvarets Forskningsanstalt, Stockholm (Sweden)). (Swedish Nuclear Fuel and Waste Management Co., Stockholm; Sveriges Geologiska Undersoekning, Uppsala; British Geological Survey, Keyworth; Foersvarets Forskningsanstalt, Stockholm (Sweden)). Sep 1987. 140p. NTIS (US Sales Only), PC A07/MF A01. Order Number DE88754189/JAW.

The analysis of the radar and seismic data has given a consistent description of the fracture zones at the Crosshole site in agreement with geological and other geophysical observations made in the boreholes. The hydraulic investigations within the Crosshole project have yielded substantial progress in assessing the hydrogeology of fractured granitic rocks. The crosshole hydraulic testing concentrated on measuring the distribution of hydraulic properties within the extensive fractured zones identified by geophysics. A new analysis involving the 'dimension' of the flow test has been developed to analyse the results of the crosshole sinusoidal testing. The combined analysis of the geophysical and the hydraulic data set has shown that groundwater flow is concentrated within a few major features which have been identified by the geophysical methods.

39398 **(SV-UB—1987-42) Geology and tectonics at Forsmark, Sweden.** Carlsson, A.; Christiansson, R. (Swedish State Power Board, Vaellingby). May 1987. 96p. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88754037/JAW.

The complex rock mass at Forsmark is mainly composed of granitic rock types. The rock mass has been broken several times by different tectonic process with intermediate phases of sealing. The rock stress measurements indicate that there is no significant difference in stress field between different rock types (local scale) or between larger intrusions. Larger structures, such as the Singoe fault, seem to influence the direction of the principal stresses. There is a tendency for stress directions to be parallel to an adjacent structure. Minor structures, such as folds and geological irregulati-

ties (such as increased joint frequency), influence the magnitude as well as the direction of the rock stresses. The theoretical shear stresses have been calculated from principal stresses. An increase in the ratio of maximum to minimum shear stresses seems to be in good agreement with more conductive parts of the rock mass, mainly because of widening of horizontal fractures.

39399 **(UCID—21326) Plan for waste package environment for NNWSI [Nevada Nuclear Waste Storage Investigations].** Glassley, W.E. (Lawrence Livermore National Lab., CA (USA)). Feb 1988. Contract W-7405-ENG-48. 45p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88010728/JAW.

The purpose and objective of the Waste Package Environment task is to establish and characterize the environmental processes affecting the near-field repository host rock after waste package emplacement. These processes, which reflect the perturbation induces in the environment by engineering effects and by the waste package decay heat and radiation, will influence chemical, mineralogical and hydrological features of the environment. The thermal and radiation output of the waste packages will change with time, resulting in an environment in which the chemical, mineralogical and physical attributes may also change through time. To assure that waste package design considerations reflect the characteristics of this evolving environment, it is necessary to determine the range of conditions that may develop in the pre- and post-emplacement waste package environment. To assure that the emplacement configurations do not compromise the lifetime of the repository or the waste packages, the design of the emplacement configuration must also consider the environmental features. Recognition of these requirements resulted in the development of the issue an information needs. 20 refs.

39400 **(UCRL—21051) Waste management study: Process development at Lawrence Livermore National Laboratory.** (Little (Arthur D.), Inc., Cambridge, MA (USA)). Dec 1984. Contract W-7405-ENG-48. 126p. NTIS, PC A07;3. Order Number DE88011312/JAW.

This report presents the results of an evaluation of the present Toxic Waste Control Operations at the Lawrence Livermore National Laboratory, evaluates the technologies most applicable to the treatment of toxic and hazardous wastes and presents conceptual designs of processes for the installation of a new decontamination and waste treatment facility (DWTF) for future treatment of these wastes.

39401 **(UCRL—53722) Hydrothermal interaction of solid wafers of Topopah Spring Tuff with J-13 water at 90 and 150{degree}C using Dickson-type, gold-bag rocking autoclaves: Long-term experiments.** Knauss, K.G.; Beiriger, W.J.; Peifer, D.W. (Lawrence Livermore National Lab., CA (USA)). May 1987. Contract W-7405-ENG-48. 23p. NTIS, PC A03/MF A01; GPO Dep. Order Number DE88005709/JAW.

The Nevada Nuclear Waste Storage Investigations Project conducted long-term experiments to study the hydrothermal interaction of rock and water representative of a potential high-level waste repository at Yucca Mountain, Nevada. The results of these experiments complement those obtained previously in short-term experiments at similar and higher temperatures. These long-term experiments also help in assessing the effects of kinetic inhibition in the precipitation of secondary minerals at the lower temperatures and allow a more complete determination of the approach of the fluid toward a steady-state composition. Considered collectively, the results of both short- and long-term experiments provide information useful in defining the near-field repository environment during and shortly after the thermal period caused by the emplacement of nuclear waste. These long-term experiments were conducted using solid wafers cut from drillcore samples of Topopah Spring tuff. A natural ground water was used as the reacting fluid. Analytical techniques for determining the composition of fluids and solids were similar to those used in previous short-term experiments. All experiments were run in Dickson-type, gold-bag rocking autoclaves that were periodically sampled under in situ conditions. Two long-term (304-day) experiments were run at temperatures of 90 and 150{degree}C and 50-bar pressure. 21 refs., 8 figs., 5 tabs.

39402 **(UCRL—95539-Rev.1) Influence of stress-induced deformations on observed water flow in fractures at the Climax granitic stock.** Wilder, D.G. (Lawrence Livermore National Lab., CA (USA)). Jun 1987. Contract W-7405-ENG-48. 9p. (CONF-870625—19-Rev.1). NTIS, PC A02/MF A01;1; GPO Dep. Order Number DE88008342/JAW.

From 28. U.S. symposium on rock mechanics; Tucson, AZ, USA (29 Jun 1987).

Three examples of stress-induced displacement influence on fracture-dominated hydrology were noted in drifts 1400 ft below surface in granite. Seepage into drifts was limited to portions of shears near a fault zone. No water entered the drifts from the fault itself, although its orientation relative to Basin and Range extension is favorable for fracture opening. Localization of seepage appears to result from excavation block motion that increased apertures of the shear zones in contrast to the fault where asperities had been destroyed by earlier shearing thus minimizing aperture increases. Seepage was also noted, in an adjoining drift, from a set of shallow-dip healed fractures that intersected the rib, and from vertical fractures that increased the crown. The restricted location of this seepage apparently was a result of shear opening of the joints that occurred because of cantilevered support of tabular rock between joints. Interpretation of paleostresses based on joint chronologies and orientations indicates that sets subjected to shear stresses at a time when normal stresses were low contained mineral infilling. Sets subjected to shear stresses at a time when the normal stresses were significant had minimal mineral infilling. 8 refs., 7 figs.

39403 **(WINCO—1053) Fitting the convective-dispersive solute-transport equation to soil column effluent data.** Thomas, T.R.; DelDebbio, J.A. (Westinghouse Idaho Nuclear Co., Inc., Idaho Falls (USA)). Apr 1988. Contract AC07-84ID12435. 40p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88011708/JAW.

Laboratory studies are being conducted to measure the rate at which various radionuclide species are transported through soil columns. Preliminary modeling studies have identified technetium-99 and selenium as having the potential to reach Snake River Plain aquifer within a 10,000-year period based on various hypothetical water-contact scenarios. It was assumed that if Tc-99 and Se-79 transport were to occur, the radionuclides would not be retarded by the soil layers in the vadose zone. The purpose of this report is to document the procedure used for data reduction. This document describes the theoretical principles behind the one-dimensional convective-dispersive solute-transport equation and its analytical solution; the least-squares fitting of the analytical function to the data by optimization of three experimental variables (retardation factor, dispersion coefficent, and solute pulse time); and statistical estimation of the 95% confidence interval for reproducibility of experimental variables using a pooled variance. 6 refs.

39404 **Designing shafts for handling high-level radioactive wastes in mined geologic repositories.** Hambley, D.F.; Morris, J.R. (Argonne National Lab., 9700 S. Cass Avenue, Argonne, IL (US)). *Nuclear Technology;* **80**: No. 3, 476-482(Mar 1988). Contract W-31-109-ENG-38.

Waste package conceptual designs developed in the United States by the U.S. Department of Energy's Office of Civilian Radioactive Waste Management are the basis for specifying the dimensions and weights of the waste package and transfer cask combinations to be hoisted in the waste handling shafts in mined geologic repositories for high-level radioactive waste. The hoist, conveyance, counterweight, and hoist ropes are then sized. Also taken into consideration are overwind and underwind arrestors and safety features required by the U.S. Nuclear Regulatory Commission. Other design features such as braking systems, chairing system design, and hoisting speed are considered in specifying waste hoisting system parameters for example repository sites.

39405 **Simulation used to qualify nuclear waste glass for disposal.** Reimus, P.W.; Kuhn, W.L. (Pacific Northwest Lab., Richland, WA (US)). pp 945-953 of Proceedings of the 1987 winter simulation conference. Thesen, A.; Grant, H.; Kelton, W.D. San Diego, CA; Society for Computer Simulation (1988). (CONF-871216—).

From Winter simulation conference; Atlanta, GA, USA (14 Dec 1987).

A hypothetical vitrification system was simulated to provide quantitative estimates of the errors associated with controlling and predicting the composition of the nuclear waste glass produced in the system. The composition of the glass must fall within certain limits in order to qualify for permanent geologic disposal. The estimated error in predicting the concentrations of various constituents in the glass was 2% to 8%, depending on the strategy for sampling and analyzing the feed and on the assumed magnitudes of the process uncertainties. The estimated error in controlling the glass composition was 2% to 9%, depending on the strategy for sampling and analyzing the waste and on the assumed magnitudes of the uncertainties. This work demonstrates that simulation techniques can be used to assist in qualifying nuclear waste glass for disposal.

39406 **Nevada v. Herrington: an ineffective check on the DOE.** Karkut, J.E. *Journal of Energy Law and Policy;* 8: No. 2, 301-318(1988).

In this decision, the United States Court of Appeals for the Ninth Circuit held that Nevada was entitled to Department of Energy (DOE) funding for certain hydrologic and geologic studies of the Yucca Mountain site. This site is located in Nye County, Nevada and could be selected as America's first high-level nuclear-waste repository. The studies' purpose is to provide independent state examination of the area's repository suitability. The court applied statutory construction principles to the Nuclear Waste Policy Act of 1982 (NWPA) to reach its decision. The decision has significance for its support of states' pre-site characterization funding rights, for the manner in which the court determined that DOE was not acting within the scope of the NWPA, and for underlying concerns left unaddressed. This Note provides background for and analysis of this decision. Factors necessitating the NWPA's passage are outlined, followed by a sketch of the events leading to this lawsuit. The court's review standard and NWPA analysis based on the statute's language and underlying congressional intent are explained. The decision is then analyzed and critiqued. Finally, a perspective viewing DOE as dangerously out of touch with NWPA statutory mandates and unrestrained in the repository selection process is expressed.

39407 **Electrochemical probing of high-level radioactive waste tanks containing washed sludge and precipitates.** Bickford, D.F.; Congdon, J.W.; Oblath, S.B. Houston, TX; National Assoc. of Corrosion Engineers (1987). 12p. (CONF-870314—). National Assoc. of Corrosion Engineers, P.O. Box 218340, Houston, TX 77218.

From Corrosion '87; San Francisco, CA, USA (9 Mar 1987).

At the U.S. Department of Energy's Savannah River Plant, corrosion of carbon steel storage tanks containing alkaline, high-level radioactive waste is controlled by specification of limits on waste composition and temperature. Processes for the preparation of waste for final disposal will result in waste with low corrosion inhibitor concentrations and, in some cases, high aromatic organic concentrations, neither of which are characteristic of previous operations. Laboratory tests, conducted to determine minimum corrosion inhibitor levels indicated pitting of carbon steel near the waterline for proposed storage conditions. In situ electrochemical measurements of full-scale radioactive process demonstrations have been conducted to assess the validity of laboratory tests. Probes included pH, Eh (potential relative to a standard hydrogen electrode), tank potential, and alloy coupons. In situ results are compared to those of the laboratory tests, with particular regard given to simulated solution composition.

39408 **Neutralizing and sorptive barriers for attenuating contaminants from acidic wastes.** Opitz, B.E. (Pacific Northwest Lab., P.O. Box 999, Richland, WA (US)). pp 524-536 of Ninth annual Madison waste conference: Municipal and industrial waste. Madison, WI; University of Wisconsin Computer Sciences Dept. (1987). (CONF-8609245—).

From 9. annual Madison waste conference; Madison, WI, USA (9 Sep 1986).

Under sponsorship of the Nuclear Regulatory Commission's Uranium Research and Recovery Program, Pacific Northwest Laboratory (PNL) investigated the use of various neutralizing reagents and techniques to attenuate the movement of contaminants associated with acidic uranium mill tailings (UMT). The objective of this study was to identify those contaminants that are not effectively attenuated by common neutralization methods and to develop alternative control measures. Results of these investigations led to the development of 1) a neutralizing barrier comprised of lime and coarse-grained sediment and 2) a tailings additive comprised of a mixture of lime and barium chloride, which, when added to acidic tailings, can reduce the amount of leachable radium escaping a designated tailings impoundment.

39409 **The fixation of high-level wastes in glasses.** Mendel, J.E. (Pacific Northwest Labs., P.O. Box 999, Richland, WA (US)). pp 49-61 of The disposal of long-lived and highly radioactive wastes. Laughton, A.S.; Roberts, L.E.J.; Wilkenson, S.D.; Gray, D.A. London, England; The Royal Society (1986). (CONF-850559—).

From Disposal of long-lived and highly radioactive waste meeting; London, UK (30 May 1985).

A plant for the fixation of high-level wastes in borosilicate glass has been operating in France since 1978. A large plant is under construction in the U.S. for the fixation of defence high-level waste and plans for other glass fixation plants are well advanced at several sites around the world. Among the reasons for the selection of borosilicate glass as a fixation medium are the relative ease of processing wastes of variable composition by means of well established technology, and the long-term radiation and thermal stability of the glass. Well formulated glass also has sufficient resistance to the action of groundwater so that it can serve as an important barrier against the spread of radionuclides via groundwater in any forseeable situation. Research is continuing to quantify the reactions of waste glass in site-specific geological repository environments.

0530 Environmental Aspects

REFER ALSO TO CITATION(S) 39242, 39246, 39282, 39283, 39284, 39285, 39286, 39287, 39288, 39289, 39290, 39291, 39292, 39293, 39294, 39295, 39296, 39297, 39298, 39299, 39300, 39301, 39302, 39303, 39304, 39305, 39306, 39307, 39308, 39309, 39310, 39311, 39312, 39313, 39314, 39315, 39316, 39317, 39318, 39319, 39336, 39337, 39338, 39339, 39340, 39341, 39342, 39344, 39346, 39347, 39349, 39350, 39352, 39353, 39355, 39373, 39374, 39377, 39378, 39382, 39383, 39384, 39385, 39388, 39390, 39391, 39392, 39393, 39394, 39399, 39402, 39403, 39416, 40304, 41320, 41321, 41365, 41371

39410 **(PB—88-189394/XAB) Health-physics survey report of Portsmouth Gaseous Diffusion Plant, Piketon, Ohio.** Bloom, T.F. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA). Div. of Surveillance, Hazard Evaluation and Field Studies). Sep 1987. 154p. (IWS—121.10). NTIS, PC A08/MF A01.

A surface alpha-activity industry-wide study was conducted at the Portsmouth Gaseous Diffusion Facility, Piketon, Ohio, as part of a response to a request from the Oil, Chemical, and Atomic Workers International Union for a cohort mortality study. The facility, operated under contract to the Department of Energy (DOE), was involved in enrichment of uranium-235 in uranium-hexafluoride gas for nuclear power and national defense purposes. A removable alpha surface-activity survey was conducted as a cross check of urinalysis data. Methodology involved comparing the numerical order in decreasing value of building geometric mean removable alpha-values with a numerical order of calculated urine alpha-value indices associated with departments in the buildings. For all surfaces measured, activity levels in the six buildings were well below the derived surface-contamination limit.

0540 Health And Safety

REFER ALSO TO CITATION(S) 39246, 39267, 39268, 39349, 39353, 41509, 41510

39411 **(CONF-871075—Vol.1-Pt.1, pp 87-102) RI/FS planning activities at Oak Ridge National Laboratory (ORNL).** Nemec, J.F.; Cook, K.W.; Wright, T.S. (Bechtel National, Inc., Oak Ridge, TN (USA)). Oct 1987. NTIS, PC A15/MF A01. Order Number DE88007803/JAW.

From 3. Oak Ridge model conference on waste problems; Oak Ridge, TN, USA (13 Oct 1987).

As was true at many of the nation's early atomic research centers, when operations at ORNL began, the risks and waste management requirements of radiological science, and production were relatively unknown. Methods of operation, environmental protection, and waste disposal at ORNL have been evolving processes, and many of the standard waste disposal methods now followed did not exist during past operations. Therefore, past practices account for the majority of the potential environmental problems affecting the ORNL Reservation. In response to this situation, the Department of Energy (DOE) and Martin Marietta Energy Systems (Energy Systems) have initiated a program for environmental restoration, the first step of which is the Remedial Investigation/Feasibility study (RI/FS) project. The project will investigate several areas of ORNL that are contaminated primarily with radioactive materials and, to a lesser extent, with hazardous chemicals. Energy Systems has organized the contaminated areas into Waste Area Groupings, or WAGs. Each WAG contains several Solid Waste Management Units, or SWMUs. The SWMUs for the most part are sites used to collect and store low level waste, such as burial trenches and pits, tanks, and impoundments. The SWMUs also include spill and leak sites identified over the years.

39412 (CONF-871075—Vol.1-Pt.1, pp 103-146) **RCRA land unit closures at the Y-12 Plant, Oak Ridge, Tennessee.** Welch, S.H.; Kelly, B.A.; Delozier, M.F.P.; Manrod, W.E. (Martin Marietta Energy Systems, Inc., Oak Ridge, TN (USA)). Oct 1987. NTIS, PC A15/MF A01. Order Number DE88007803/JAW.

From 3. Oak Ridge model conference on waste problems; Oak Ridge, TN, USA (13 Oct 1987).

Eight land-based hazardous waste management units at the Y-12 Plant are being closed under an integrated multi-year program. Closure plans for the units have been submitted and are in various stages of revision and regulatory review. These units will be closed by various combinations of methods, including liquid removal and treatment, sludge stabilization, contaminated sludge and/or soil removal, and capping. The closure of these sites will be funded by a new Department of Energy budget category, the Environmental Restoration Budget Category (ERBC), which is intended to provide greater flexibility in the response to closure and remedial activities. A major project, Closure and Post-Closure Activities (CAPCA), has been identified for ERBC funding to close and remediate the land units in accordance with RCRA requirements. Establishing the scope of this program has required the development of a detailed set of assumptions and a confirmation program for each assumption. Other significant activities in the CAPCA program include the development of risk assessments and the preparation of an integrated schedule.

39413 (CONF-871075—Vol.1-Pt.1, pp 149-171) **ORGDP RCRA facility investigation program: plans and content.** Haymore, J.L. (Martin Marietta Energy Systems, Inc., Oak Ridge, TN (USA)). Oct 1987. NTIS, PC A15/MF A01. Order Number DE88007803/JAW. Contract AC05-84OR21400.

From 3. Oak Ridge model conference on waste problems; Oak Ridge, TN, USA (13 Oct 1987).

Preparation of RCRA Facility Investigation (RFI) plans for thirty four 3004(u) sites at the ORGDP will be accomplished during FY-87 and FY-88. The plans will be written to guide the sampling and analyses of the sites to determine the extent, if any, of contamination. This investigation will then be the cornerstone for design of corrective measures for site remediation. The RFI plans at the ORGDP are being prepared by two Martin Marietta Energy Systems, Inc., project teams. The organization of the teams, the schedules, and the costs associated with preparation of the documents will be discussed. The contents of the general RFI plan document and a typical site-specific plan will be shown and the contents and methodology of each section will be highlighted.

39414 (CONF-871075—Vol.1-Pt.1, pp 173-183) **How clean is clean - a review of Superfund cleanups.** Bacs, C.F. III; Marland, G. (Oak Ridge National Lab., TN (USA)). Oct 1987. NTIS, PC A15/MF A01. Order Number DE88007803/JAW. Contract AC05-84OR21400.

From 3. Oak Ridge model conference on waste problems; Oak Ridge, TN, USA (13 Oct 1987).

The Superfund Amendments and Reauthorization Act (SARA) requires that remedial actions assure protection of human health and the environment and identifies (1) Maximum Contaminant Level Goals (MCLGs) set under the Safe Drinking Water Act and (2) water quality criteria established under Sections 303 and 304 of the Clean Water Act as appropriate and relevant standards for cleanup. The authors examined whether the standards specified in SARA are being attained by reviewing 42 recent Records of Decision (RODs) for Superfund cleanups. In addition to the technical, legal, and financial criteria set forth in SARA, the authors reviewed the following issues involved in determining cleanup levels for hazardous constituents in soils and ground water: what does the EPA expect? What standards are being enforced? What are the boundaries between containment and cleanup? What are the impacts of site size, complexity, pollutant composition, and pollutant volume? What are the impacts of involvement of potentially responsible parties (PRPs)? How and when are waivers to applicable or relevant and appropriate regulations (ARARs) used? The authors also analyzed for temporal trends and consistency in cleanup standards across regions. Finally, they focused on the policy and political issues involved in setting cleanup standards and on public and Congressional reactions and perceptions, e.g., the EPA's use of Maximum Containment Levels (MCLs) rather than the more stringent MCLGs in setting cleanup standards. This paper presents the results of the review and analysis.

39415 (CONF-871075—Vol.1-Pt.1, pp 185-201) **Case study: FUSRAP in New Jersey (1980-1987).** Kannard, J.R. (Bechtel National, Inc., Oak Ridge, TN (USA)). Oct 1987. NTIS, PC A15/MF A01. Order Number DE88007803/JAW.

From 3. Oak Ridge model conference on waste problems; Oak Ridge, TN, USA (13 Oct 1987).

The State of New Jersey brings to mind a number of images, most of which are associated with its proximity to New York City. It is not strictly, however, a state of big city problems and industrialization. It is a state of striking contrasts; and in a similar way, DOE's Formerly Utilized Sites Remedial Action Program (FUSRAP) in New Jersey is a program of contrasts. FUSRAP in New Jersey consists of five sites, representing 17% of all sites in the FUSRAP program. Two of those sites, Kellex in Jersey City and DuPont in Deepwater, have not been included in recent program activities, and the case study will concentrate only on the other three - one in Middlesex, one in Wayne, and one in Maywood. Each of these is being used as an interim storage site for contaminated material from vicinity properties. Each also represents a distinct stage of completion of interim remedial action. Middlesex is complete, Wayne is nearing completion, and Maywood is still in the characterization stage with some remedial action also having been accomplished. Contrasts range from drastically different attitudes in the public and local government sector to significant differences in quantities of contaminated materials, and the mechanisms by which these migrated to vicinity properties. And, in each case, the main concern on the part of the public is lack of a location for permanent disposal. These issues along with the history, objectives, and accomplishments for each site are discussed.

39416 **(DOE/EA—0311) Environmental assessment of remedial action at vicinity properties associated with the former Climax Uranium Company Uranium Mill Site, Grand Junction, Mesa County, Colorado.** (USDOE Albuquerque Operations Office, NM. Uranium Mill Tailings Remedial Action Project Office). Jul 1986. 142p. NTIS, PC A07/MF A01;1; GPO Dep. Order Number DE88011446/JAW.

This document assesses and compares the environmental impacts of various alternatives for remedial action at the UMTRA Project vicinity properties in Mesa County, Colorado. Vicinity properties are homes, businesses, public buildings, and vacant lots which may have been contaminated during construction by the use of tailings as a building material or as fill material before the hazards associated with this material were known. It is estimated that 3585 contaminated properties remain to be formally included on the vicinity property list and thereby require remedial action. The Uranium Mill Tailings Radiation Control Act (UMTRCA) of 1978, Public Law 95-604, authorized the US Department of Energy to perform remedial action at these properties. The US Environmental

Protection Agency promulqated standards for remedial action (40 CRF Part 192). The alternatives addressed in this environmental assessment (EA) including taking no action toward remedial action at the vicinity properties, conducting remedial action at a rate of 500 properties per year, and conducting remedial action at a rate of 800 properties per year. 3 figs., 4 tabs.

39417 **(DOE/EH—8013171) Environment, safety and health report for the Department of Energy defense complex: Executive summary.** (USDOE, Washington, DC). 1 Jul 1988. 7p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88013171/JAW.

This environment, safety, and health report for the US Department of Energy's (DOE) defense complex provides a summary of current and projected activities and the associated resources that will be necessary to clean up environment contamination and to achieve and maintain compliance with environment, safety, and health requirements. It reflects the best address available as part of the Department's continuing process to address current requirements and problems. 4 figs.

39418 **(DOE/EH—8013172) Environment, safety and health report for the Department of Energy defense complex.** (USDOE, Washington, DC). 1 Jul 1988. 152p. NTIS, PC A08/MF A01; 1; GPO Dep. Order Number DE88013172/JAW.

This environment, safety, and health (ES and H) report highlights the policy, planning, and program activities that contribute to achieving and maintaining compliance with current ES and H requirements. The report focuses on the Department of Energy (DOE) Defense Programs sites and their efforts to clean up environmental contamination and assure and maintain compliance with ES and H standards. Each DOE headquarters program office (Defense Programs, Energy Research, Nuclear Energy, Fossil Energy, and Conservation and Renewable Energy being the major offices) is responsible for assuring that sites under their purview meet all Departmental requirements, including ES and H standards. A DOE-wide report will be provided in December 1988. 14 figs., 1 tab.

39419 **(DOE/OR/20722—198) Middlesex Sampling Plant and Middlesex Municipal Landfill, annual site environmental report, Middlesex, New Jersey, calendar year 1987: Formerly Utilized Sites Remedial Action Program (FUSRAP).** (Bechtel National, Inc., Oak Ridge, TN (USA)). Apr 1988. Contract AC05-81OR20722. 85p. NTIS, PC A05/MF A01;1; GPO Dep. Order Number DE88008660/JAW.

The monitoring program at the Middlesex Sampling Plant (MSP) and Middlesex Municipal Landfill (MML) measures radon gas concentrations in air; external gamma radiation levels; and uranium and radium concentrations in surface water, groundwater, and sediment. To verify that the sites are in compliance with the DOE radiation protection standard (100 mrem/yr) and to assess their potential effect on public health, the radiation dose was calculated for the maximally exposed individual. Based on the conservative scenarios described in the report, this individual, at the MSP, would receive an annual external exposure approximately equivalent to 10 percent of the DOE radiation protection standard. By comparison, the incremental dose received from living in a brick house as opposed to a wooden house is about the same. At the MML, the annual external exposure to the maximally exposed individual would be less than 1 percent of the standard. The cumulative dose to the population within an 80-km (50-mi) radius of the sites that would result from radioactive materials present at the MSP and MML would be indistinguishable from the dose that the same population would receive from naturally occurring radioactive sources. Results of the 1987 monitoring show that the MSP and MML are in compliance with the DOE radiation protection standard. 14 refs., 11 figs., 22 tabs.

39420 **(FMPC—2114-Rev.1) Environment, safety, health and waste management plan: April 1988.** (Westinghouse Materials Co. of Ohio, Cincinnati (USA). Feed Materials Production Center). Apr 1988. Contract AC05-84OR21400. 227p. NTIS, PC A11/MF A01;1; GPO Dep. Order Number DE88011633/JAW.

The mission of the Feed Materials Production Center (FMPC) is the production of high-quality uranium metal for use by the US Department of Energy (DOE) in Defense Programs. In order to accomplish this mission and to maintain the FMPC as a viable facility in the DOE production complex, the facility must be brought into full compliance with all federal and state regulations and industry standards for environmental protection and worker safety. The purpose of this combined Environment, Safety, Health and Waste Management Plan is to provide a road map for achieving these needed improvements. The plan is structured to provide a comprehensive projection from the current fiscal year (FY) through FY-1994 of the programs, projects and funding required to achieve compliance. To do this, the plan is subdivided into chapters which discuss the applicable regulations (Chapter 2); project schedules and funding requirements (Chapter 3); details of the various programs for environment, safety, health and waste management (Chapters 4-10); details for compliance with National Environmental Policy Act (NEPA) (Chapter 11); the Quality Assurance Program (Chapter 12) and the Environmental Monitoring Program (Chapter 13). 22 figs., 28 tabs.

0550 Safeguards, Inspection, And Accountability

REFER ALSO TO CITATION(S) 39249, 39261, 39372, 39776, 40607

39421 **(DOE/DP—0051) Strategic special nuclear material inventory differences: Semiannual report.** (USDOE Assistant Secretary for Defense Programs, Washington, DC. Office of Safeguards and Security). Jul 1988. 33p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88012406/JAW.

This twenty-second periodic semiannual report of unclassified Inventory Differences (ID's) covers the last six months of fiscal year 1987 (April 1, 1987 through September 30, 1987) for all key Department of Energy (DOE) and DOE contractor operated facilities possessing strategic special nuclear materials. Data for the Rocky Flats and Y-12 nuclear weapons production facilities are not included in the report in order to protect classified nuclear weapons information; however, classified ID data from these facilities receive the same scrutiny and analyses as the unclassified data.

39422 **(DP-MS—88-88) Shipment/receipts resolution program.** Davis, F.B. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Plant). 1988. Contract AC09-76SR00001. 4p. (CONF-880631—9). NTIS, PC A02/MF A01;1; GPO Dep. Order Number DE88011817/JAW.

From 29. annual meeting of the Institute of Nuclear Materials Management; Las Vegas, NV, USA (26 Jun 1988).

Savannah River Plant (SRP) has initiated an aggressive program aimed at improving our shipper/receiver (S/R) posture. The site is routinely involved in 800 nuclear material transfers/year. This many transactions betweeen facilities provides many opportunities for resolving S/R differences. Resolution of S/R differences requires considerable effort from both DOE offices and contractors, presents legitimate safeguards concerns if the receiving quanity is less than the quanity shipped, and must be resolved for shipments to continue. This paper will discuss the programs in place SRP to improve our position versus shipments and receipts of nuclear materials including: S/R agreements, which provide a method of communicating between the shipping and receiving facilities and protects both facilities by eliminating misunderstandings. Nondestructive assay (NDA) instrumentation, which allows the facility to obtain an accountability quality value for receipt before the material is processed. More accurate and precise analytical techniques in use wherever SRP does not have the capability to measure a shipment or receipt by NDA. S/R values are graphed to identify trends and/or biases that may not have exceeded any error limits. The central Material Control and Accountability (MC&A) division has become more involved in analyzing the data from shipments and receipts including the calculation of limits of error (LOE's), instrument biases, and analyzing trends.

39423 **(INIS-BR—1120) Nuclear material control in Brazil.** Marzo, M.A.S.; Iskin, M.C.L.; Palhares, L.C.; Almeida, S.G. de. (Comissao Nacional de Energia Nuclear de Brasil, Rio de Janeiro). 1988. 29p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703221/JAW.

A general view about the safeguards activities in Brazil is presented. The national system of accounting for and control of nuclear materials is described. The safeguards agreements signed by Brazil are presented, the facilities and nuclear material under these agreements are listed, and the dificulties on the pratical implementation are discussed. (E.G.).

39424 **(INIS-BR—1121) Nuclear material measurement system in Brazil.** Almeida, S.G. de. (Comissao Nacional de Energia Nuclear de Brasil, Rio de Janeiro. Lab. de Salvaguardas). 1988. 12p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703222/JAW.

The description of the activities developed at the Safeguards Laboratory of Brazilian Nuclear Energy Commission is done. The methods and techniques used for measuring and evaluating nuclear materials and facilities are presented. (E.G.).

39425 **(INIS-BR—1122) Nuclear material control in Spain.** Velilla, A. (Comissao Nacional de Energia Nuclear de Brasil, Rio de Janeiro. Lab. de Salvaguardas). 1988. 30p. (In Spanish). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703223/JAW.

A general view about the safeguards activities in Spain is presented. The national system of accounting for and control of nuclear materials is described. The safeguards agreements signed by Spain are presented and the facilities and nuclear materials under these agreements are listed. (E.G.).

39426 **(INIS-BR—1125) Control of nuclear materials and materials in Argentina.** Arbor G, A.; Fernandes M, S. (Comision Nacional de Energia Atomica, Buenos Aires (Argentina)). 1988. 41p. (In Spanish). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703226/JAW.

A general view about the safeguards activities in Argentina is presented. The national system of accounting for and control of nuclear materials is described. The safeguards agreement signed by Argentina are presented. (E.G.).

39427 **(INIS-BR—1126) Nuclear materials control at 'Fabrica de Elementos Combustiveis - FEC - da Nuclebras'.** Paiva, J.R.T. de. (NUCLEBRAS, Rio de Janeiro (Brazil)). 1988. 13p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703227/JAW.

A description of the nuclear materials control in the fuel fabrication plants - FEC from Nuclebras is done. Some schemes used for controlling this nuclear facility are shown. (E.G.).

39428 **(JAERI-M—88-059) Study of statistical tests for near-real-time materials accountancy using field test data of Tokai reprocessing plant.** Ihara, Hitoshi; Nishimura, Hideo; Ikawa, Koji; Miura, Nobuyuki; Iwanaga, Masayuki; Kusano, Toshitsugu. (Japan Atomic Energy Research Inst., Tokyo). Mar 1988. 113p. NTIS (US Sales Only), PC A06/MF A01. Order Number DE88754128/JAW.

An Near-Real-Time Materials Accountancy(NRTA) system had been developed as an advanced safeguards measure for PNC Tokai Reprocessing Plant; a minicomputer system for NRTA data processing was designed and constructed. A full scale field test was carried out as a JASPAS(Japan Support Program for Agency Safeguards) project with the Agency's participation and the NRTA data processing system was used. Using this field test data, investigation of the detection power of a statistical test under real circumstances was carried out for five statistical tests, i.e., a significance test of MUF, CUMUF test, average loss test, MUF residual test and Page's test on MUF residuals. The result shows that the CUMUF test, average loss test, MUF residual test and the Page's test on MUF residual test are useful to detect a significant loss or diversion. An unmeasured inventory estimation model for the PNC reprocessing plant was developed in this study. Using this model, the field test data from the C-1 to 85 - 2 campaigns were re-analyzed.

39429 **(LA—11275-MS) Bibliography for Safeguards, 1980-1984.** Jaramillo, G.; Simpson, J. (Los Alamos National Lab., NM (USA)). 1988. Contract W-7405-ENG-36. 33p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88011712/JAW.

This bibliography is a compilation of technical reports and publications generated by the Los Alamos National Laboratory's Safeguards and Security R&D Program from 1980--1984. 364 refs.

39430 **(ORNL/CSD/TM—255) Safeguards Analytical Laboratory mass spectrometer procedures for calibration and isotopic ratio estimation:.** Bayne, C.K. (Oak Ridge National Lab., TN (USA)). Mar 1988. Contract AC05-84OR21400. 53p. (ISPO—283). NTIS, PC A04/MF A01;1; GPO Dep. Order Number DE88008991/JAW.

This report examines quality control procedures for mass spectrometric measurements. The statistical properties are evaluated for the current methods used for calibration and for isotopic ratio estimation. New calibration and estimation formulas are recommended to improve the statistical properties of these present methods. The mass spectrometers, ISOMASS-54E and MAT-261, are calibrated using the $^{235}U/^{233}U$ isotopic ratio. The data sets contain 58 and 41 measured ratios for the ISOMASS-54E and the MAT-261, respectively. A statistical analysis shows that a linear model through the origin is valid for ratios ranging from 0.01 to 17.35 with no significant quadratic curvature. However, the variances of the measurements are not constant over this range. This heterogeneity of variances indicated that weighted regression is the appropriate method to estimate the bias factor. A computer simulation of a mass spectrometer examined estimated $^{235}U/^{233}U$ isotopic ratios with true values of 0.01, 0.25, 1, 10, and 17.35. The simulation results are based on 10,000 samples for each isotopic ratio value. This study showed that the present method of calculating $^{235}U/^{235}U$ isotopic ratios on the ISOMASS-54E is unbiased for isotopic ratios ranging from 0.01 to 17.35. However, the variances of estimated isotopic ratios are greatly underestimated. An error propagation formula can be used to estimate these variances and gave reasonable approximations to the results of the simulation study. The alternative estimation method of the ratio of average intensities also gives unbiased estimates of $^{235}U/^{238}U$, but variance estimates are closer to the simulated variance estimates. 11 refs., 7 figs., 19 tabs.

39431 **(SAND—88-1439C) Fencing intruders out.** Madsen, R.W. (Sandia National Labs., Albuquerque, NM (USA)). 1988. Contract AC04-76DP00789. 10p. (CONF-880631—7). NTIS, PC A02/MF A01;1; GPO Dep. Order Number DE88011185/JAW.

From 29. annual meeting of the Institute of Nuclear Materials Management; Las Vegas, NV, USA (26 Jun 1988).

Chain link fences are a component of almost every perimeter security system, and their use ranges from simply delineating a boundary to supporting sophisticated intrusion detectors. Standard chain link fences provide little delay, and often, fence-mounted sensors can be circumvented by using a lightweight ladder to jump over the fence with minimum fence disturbance. This investigation summarizes the results of approximately four hundred intrusions against several sensor combinations and fences from seven to twelve feet high. Fence climbing delays range from three to twenty seconds, depending on the fence and sensor combination used, and detection probabilities vary from low, in some cases, to very high for one configuration which has never been crossed without an alarm. A perimeter fence/barrier/sensor combination designed to delay and discourage intruders and provide for a high probability of detection is discussed as an end result of the investigation. 5 figs., 1 tab.

0560 Legislation And Regulations

REFER ALSO TO CITATION(S) 39245, 39345, 39351, 39404, 39718

39432 (CONF-871075—Vol.1-Pt.1, pp 43-50) Recommendations concerning Tennessee's hazardous waste management policies by a task force representing generators, environmentalists, and other key constituencies. Colglazier, E.W.; English, M.R. (Univ. of Tennessee, Knoxville (USA)). Oct 1987. NTIS, PC A15/MF A01. Order Number DE88007803/JAW.

From 3. Oak Ridge model conference on waste problems; Oak Ridge, TN, USA (13 Oct 1987).

Four recommendations are proposed. 1) A Governor's Roundtable on Hazardous and Solid Wastes should be established to ensure that Tennessee have sound policies and plans for waste management, adequate waste treatment and disposal capacity, and the means to meet the October, 1989 deadline for certification of hazardous waste capacity. 2) Opportunities for early public information and participation in Tennessee's RCRA permitting process should be improved. 3) A Superfund Public Involvement Task Force should be appointed by the Commissioner of Health and Environment to find ways to ensure that a community affected by a Tennessee Superfund site has early and adequate opportunities for information and involvement. 4) Communications about hazardous waste issues should be improved by the appointment of a hazardous waste information officer, the establishment of a Speakers Bureau, the funding of the UT Center for Industrial Services' Hazardous Waste Extension Program, establishment of a crisis situation network of consultants for communities, and exploration of the possibility of Amnesty Days for household hazardous waste and for small-quantity generators waste.

07 ISOTOPE AND RADIATION SOURCE TECHNOLOGY

0702 Radiation Sources

REFER ALSO TO CITATION(S) 39430, 40763

39433 (CEA-CONF—9221) Decantation study of fine sediments in the well of a suction dredge by means of a nuclear gage. Meyer, G. (Compagnie ORIS Industrie, 91 - Gif-sur-Yvette (France)). Feb 1986. 10p. (In French). (CONF-8603210—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88753595/JAW.

From 11. world dredging congress; Brighton, UK (4 Mar 1986).

A gage based on diffusion of gamma radiations emitted by a source of cesium 137 follows in function of time sediment decantation. The decantation is studied in different parts of the well for optimization of the filling technique and measuring the mass of dry sediment accumulated.

39434 (JAERI-M—88-015) Study on saccharification of cellulosic wastes with bench scale test plant, (3). Effect of alkali pretreatment on chaff. Kasai, Noboru; Tamada, Masao; Kumakura, Minoru; Kaetsu, Isao. (Japan Atomic Energy Research Inst., Tokyo). Feb 1988. 19p. (In Japanese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88753630/JAW.

Effects of alkali treatment and a combination of alkali, irradiation, and pulverizing treatment on saccharification of chaff have been studied. Alkali treatment of chaff was effective for saccharification as higher alkali concentration as possible. Chaff that was treated with alkali concentration of 4 % gave a higher glucose concentration solution than untreated chaff by a factor of 4, due to increase of enzyme accessibility resulting from delignification. Chaff obtained with a combination of alkali, irradiation, and pulverizing treatment gave a higher glucose concentration solution than untreated chaff by a factor of maximum 10, in which it was found that the glucose concentration of the solution depends on the order of the treatments.

39435 (PB—88-206222/XAB) Room-clearance and radiation-safety interlock system for neutron-therapy treatment room. Thomas, H.; Jones, D.T.L.; Hendrikse, W.L.J. (Council for Scientific and Industrial Research, Faure (South Africa). National Accelerator Centre). Feb 1987. 39p. (NAC—87-01). NTIS, PC E05/MF E05.

North American Continent sales only.

The NAC neutron-therapy treatment room houses an isocentric gantry in which neutrons are produced by the reaction of 66-MeV protons on a beryllium target. A fail-safe room clearance and radiation safety interlock system was designed to prevent accidental radiation exposure of personnel. The room-clearance procedure has to be successfully completed before it is possible for the beam to be directed into the treatment room. Should the safety barriers be penetrated after the beam has been directed into the room, the beam will automatically be shut off. A full description of the features of the system and the procedures to be followed are described, and all relevant electronic circuits are detailed.

39436 (PB—88-211818/XAB) NBS (National Bureau of Standards) measurement services: neutron-source-strength calibrations. Final report. McGarry, E.D.; Boswell, E.W. (National Bureau of Standards, Washington, DC (USA). Center for Radiation Research). Mar 1988. 62p. (NBS/SP—250-18). NTIS, PC A04/MF A01.

Also available from Supt. of Docs. See also PB—87-174041; Library of Congress catalog card No. 88-600510.

The manganese sulfate ($MnSO_4$) bath method of neutron source strength calibration at NBS is described and compared briefly with other $MnSO_4$ bath techniques used internationally. The accuracy of source intercomparisons and practical limitations of the NBS system. In particular, there is discussion of uncertainties associated with system limitations and with corrections necessary for neutron capture in the source, capture of fast and thermal neutrons by competing reactions in the $MnSO_4$, capture of neutrons in the source container, and the correction for leakage of neutrons from the bath, which is 1.27 meters in diameter.

39437 Radioiodinated maleimides and use as agents for radiolabeling antibodies. Srivastava, P.C. (to Dept. of Energy, Washington, DC). US Patent 4,735,792. 5 Apr 1988. Filed date 28 Apr 1987. vp. Patent and Trademark Office, Box 9, Washington, DC 20232.

A compound is described comprising a maleimide having a radiohalogenated phenyl at the nitrogen site, the phenyl having a radiohalogen at the paraposition, wherein the radiohalogen is selected from the group bromine-75, bromine-76, bromine-82, iodine-123, iodine-125, iodine-131 and fluorine-18.

39438 Cryogenic system for fusion neutron irradiation and in-situ measurements on superconductors. Hahn, P.A.; Guinan, M.W. (Lawrence Livermore National Lab., CA (USA)). pp 639-646 of Advances in cryogenic engineering. Volume 33. Fast, R.W. (ed.). New York, NY; Plenum Press (1988). (CONF-8706125—). Contract W-7405-ENG-48.

From Cryogenic engineering conference; St. Charles, IL, USA (14 Jun 1987).

A liquid helium flow cryostat for irradiating Nb_3Sn samples below 20 K with fusion (14.6 MeV) neutrons at the Rotating Target Neutron Source (RTNS-II) in Livermore and subsequent in-situ measurements of the critical temperature and critical current in magnetic fields up to 15.6 tesla has been employed in recent experiments. After each irradiation cycle the flow cryostat was removed from the target without warmup and inserted into a split superconducting solenoid with the field enhanced by holmium flux concentrators. The engineering aspects of the cryogenic system, the technical constraints encountered during its design, and its performance under operating conditions are discussed.

0703 Isotopic Power Supplies

39439 (LA—11217-PR) Milliwatt generator project: Progress report, April 1982-March 1983. Rinehart, G.H.; Latimer, T.W. (Los Alamos National Lab., NM (USA)). May 1988. Contract W-7405-ENG-36. 33p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88010697/JAW.

This report covers progress on the Milliwatt Generator Project during April 1982-March 1983. Activities included fuel processing and characterization, production of heat sources, fabrication of pressure-burst test units, compatibility studies, examination of surveillance units, and impact testing. The fuel was plutonium-238 dioxide. 4 refs., 28 figs., 17 tabs.

08 HYDROGEN

0801 Production

REFER ALSO TO CITATION(S) 39063, 39444

39440 (AD-A—191355/7/XAB) Electrochemical hydrogen concentrator for phosphoric acid fuel cells. Final report, 30 September 1986-30 September 1987. Giner, J.; Kackley, N.D. (Giner, Inc., Waltham, MA (USA)). Nov 1987. 36p. (C—86-14). NTIS, PC A03/MF A01.

The production of high-purity hydrogen for use in phosphoric acid fuel cell from heavily contaminated reformed diesel-fuel gas using an electrochemical device was demonstrated. The electrochemical hydrogen separator (EHS) is based on current PAFC technology. Hydrogen is removed from the contaminated gas stream by oxidation to hydrogen ions at a gas-diffusion cathode. An anode catalyst with excellent tolerance to high levels of CO and H_2S contaminants was developed. The use of this anode catalyst would allow the EHS device to produce pure hydrogen with minimal voltage impact on the overall PAFC power output. Reduction in size and weight of the PAFC power plant is also indicated through reduced load on fuel processing components.

39441 (CONF-880767—1) Photosynthetic water splitting. Greenbaum, E. (Oak Ridge National Lab., TN (USA)). 1988. Contract AC05-84OR21400. 13p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88011021/JAW.

From 7. international conference on photochemical conversion and storage of solar energy; Evanston, IL, USA (31 Jul 1988).

This paper presents recent progress in the field of photosynthetic water splitting for both on vitro and in vivo systems. It is demonstrated that platinized chloroplasts are a novel photocatalytic material that is capable of the sustained simultaneous photoevolution of hydrogen and oxygen when irradiated with visible light. By using the technique of single-turnover saturating flashes of light an upper limit can be set on the number of platinum atoms that are neccesary for the formation of a catalytically active cluster. The results of these experiments indicate that the onset of catalytic hydrogen evolution during the creation of platinum metal catalyst can be observed with 50 atoms or less, and that a stable metal catalyst is created at about 500 atoms or less. Absolute thermodynamic efficiencies of conversion of light energy into chemical free-energy of molecular hydrogen by intact microalgae have been measured with an original physical measuring technique using a tin-oxide semiconducting gas sensor. Thin films of microalgae comprising 5--20 cellular monolayers have been entrapped on filter paper, thereby constraining them in a well-defined circular geometry. Based on absolute light absorption of visible polychromatic illumination in the low-intensity region of the light saturation curve, conversion efficiencies of 6 to 24% have been obtained. These values are the highest ever measured for hydrogen evolution by green algae. 35 refs., 5 figs., 1 tab.

39442 (MC/C—B26A) Texaco gasification (vvc 90% pitch) for hydrogen production with CO/sub 2/ export. (Monenco Consultants Ltd., Calgary, Alberta (Canada)). 21 Mar 1986. 31p. (CE—01476). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

Data are presented in tabular and diagrammatic form on a proposed gasification plant. This plant includes a gas cleanup unit utilizing the Selexol process, which produces two byproducts, hydrogen sulfide-rich acid gas and carbon dioxide. This report develops the cost of producing pure hydrogen as well as the cost associated with delivery of the carbon dioxide at the plant battery limit. Alternative costs for a 50 mile and a 200 mile pipeline are also developed. Discussion and relevant data are given relating to plant operation and design, capital costs, operating and maintenance costs, utility requirements and production rates of the various products and byproducts. 3 figs. 14 tabs.

39443 Synthesis and reactions of anionic metallocarboxylates of iron. Gibson, D.H.; Ong, T.S. (Univ. of Louisville, KY (USA)). *Journal of the American Chemical Society;* **109**: No. 23, 7191-7193(11 Nov 1987).

Interest in both metallocarboxylic acids and their conjugate bases derives from their proposed intermediacy in metal carbonyl catalyzed water gas shift (WGS) reactions. However, few of the acids and fewer of the anionic metallocarboxylate complexes have been characterized. Syntheses of the anionic complexes have resulted from either direct carbonation of a metal anion or deprotonation of a metallocarboxylic acid; in only a few cases has isolation been possible. The authors report here the isolation and characterization of $M[FeCp(CO)(PPh_3)(CO_2)]$ (M = Li and K; Cp = eta-C_5H_5), their behavior toward electrophiles, and their thermolysis reactions.

0803 Transport

39444 (EUR—11329) Hydrogen supply over long distances using chemicals description and evaluation of a technical system. Giacomazzi, G. (Commission of the European Communities, Ispra (Italy). Joint Research Centre). 1987. 30p. NTIS (US Sales Only), PC A03;1; GPO Dep. Order Number DE88012630/JAW.

The problem of the transport of hydrogen has been studied. The basic concept was the following: where electricity is available at low cost as compared to European costs, it is possible to produce hydrogen by electrolysis, also at low cost; if it is possible to transport the hydrogen in Europe at costs which are not prohibitive, one would thus have in Europe a low-cost energy vector. That electricity is available at low cost true only in certain parts of the world which are either a long way from Europe and/or geographically and climatically difficult. In fact, it can be transmitted by pipeline in gaseous form but it cannot be transported in bulk by sea in liquid form (LH2) at normal pressure such as, for example, the liquefied natural gas, because of lack, at the present state of technology, of suitable ships. Also the transportation in relatively small tanks by special ships should be excluded because of the physical characteristics of hydrogen. These facts exclude sites of hydrogen production which are separated from the sites of use by the sea. Economics and some conclusions of hydrogen transport are presented. 15 refs., 7 figs., 13 tabs.

0804 Marketing And Economics

REFER ALSO TO CITATION(S) 39444

09 OTHER SYNTHETIC AND NATURAL FUELS

0901 Hydrocarbon Fuels

REFER ALSO TO CITATION(S) 39997

39445 (AD-A—190976/1/XAB) Catalytic investigations with the stopped-flow gas-chromatographic reactor. Powell, J.B.; Jeng, C.Y.; Langer, S.H. (Wisconsin Univ., Madison (USA). Dept. of Chemical Engineering). 1987. 8p. NTIS, PC A02/MF A01.

Pub. in Chemical Engineering Science, Vol. 42, No. 7, 1797-1803(1987).

The potential of the stopped-flow gas chromatographic reactor (SFGCR) for catalytic investigations was examined through application to methanation studies over alumina-supported nickel and ruthenium catalysts at 375-500 K. It was found that for the SFGCR, the significance of transport resistances could be evaluated more readily than is generally possible with steady-state differential-flow reactors. Methods for determining the effects of stopped-flow intervals and reversible desorption of reactant on observed rates were also developed. It was demonstrated that, for these systems, the SFGCR could be operated such that only surface-reaction phenomena contributed measurably to observed reaction rates. Rate behavior could be explained by surface heterogeneity, which was substantiated by results from temperature-programmed reaction studies and stopped-flow experiments at varying metal dispersions. The SFGCR was demonstrated to be useful for rapid screening for catalytic activity and structure sensitivity as well as measurement of small rates of reaction.

39446 (AU/CE—091982) Anaerobic methanogenic treatment of phenolic wastewaters. Fedorak, P.M.; Hrudey, S.E. (Alberta Univ., Edmonton (Canada). Dept. of Civil Engineering). Sep 1982. 117p. (CE—01708). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

Batch culture experiments using domestic anaerobic sewage sludge were carried out with a variety of aromatic compounds to determine whether methanogenic fermentations of these substrates could be established. Of the 11 phenolics tested, only phenol and p-cresol were fermented to methane. The acclimation time for the degradation of these two substrates increased as their concentrations increased. In batch cultures, phenol or p-cresol were not degraded when their concentrations were greater than 500 and 400 mg/l respectively, although at higher concentrations, the methanogenic fermentations of non-phenolic substrates were not inhibited. Thus the phenolic-degrading bacteria are more susceptible to inhibition by the toxic substrates than are the methane bacteria. Four dimethylphenol isomers inhibited methane fermentation at 500 but not at 300 mg/l. Maximum degradation rates for phenol and p-cresol were found to be 42 and 52 mg/l/d respectively. Draw-and-feed cultures were established on these substrates, and the phenol-degrading culture showed a substrate removal efficiency of over 99.8%. The reactor, operated with a hydraulic retention time of 25 d and a solids retention time approaching infinity, received a nutrient solution containing 500 mg/l phenol. Preliminary batch cultures inoculated with oil sands tailings pond sludge indicate that microorganisms may exist therein, which are capable of anaerobically degrading o- and m-cresol, 2,5- and 3,5-dimethylphenol, and 3,4-dihydroxytoluene. Overall, these findings indicate that the anaerobic methanogenic degradation of phenolic wastewaters is biochemically feasible. 110 refs., 18 figs., 11 tabs.

39447 (DOE/ER/13370—3) Microbial ecology of thermophilic anaerobic digestion: [Progress report, year 3]. Zinder, S.H. (Cornell Univ., Ithaca, NY (USA). Dept. of Microbiology). [1988]. Contract FG02-85ER13370. 4p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE88008358/JAW.

The goal of this project is to gain a more complete understanding of the microorganisms converting a lignocellulose waste to methane in a thermophilic (58{degree}C) anaerobic bioreactor. We have directly examined microbial populations in the bioreactor and have examined the properties of microorganisms isolated from the bioreactor. The primary focus has been on anaerobic thermophiles involved in the formation and degradation of acetic acid, the precursor of two-thirds of the methane produced in the bioreactor. Also, novel organisms of fundamental and practical significance have been isolated and characterized.

39448 (FRNC-TH—3163) Evaluation of emerging technics: methodologic elements and application to biomass gasification for electric production. Steck, D. (Ecole Centrale des Arts et Manufactures, 92 - Chatenay-Malabry (France)). 1985. 230p. (In French). NTIS (US Sales Only), PC A11/MF A01. Order Number DE88753848/JAW.

The choice between the various alternative technologies and the dominant technology is not easy. Are they all valid, one, or none. A method is proposed here, that intends to give a response to that choice, based on the example of biomass gasification for low and medium-scale power production. Using this method, it can be derived that the biomass gasification market is situated in the developing countries, that the economic efficiency US. petrodeum is acquired in numerous conditions but that reliability remains uncertain.

39449 (FRNC-TH—3238) Up-grading and pollution abatement of oil mill waste waters. Gharsallah, N. (Universite de Technologie de Compiegne, 60 (France)). Jul 1987. 182p. (In French). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88753853/JAW.

A review of the aerobic and anaerobic waste water processes is presented at first. Growth kinetics of saccharomyces rouxii, Candida krusei and saccharomyces chevalierie are studied in order to select the most performant yeast. The growth parameters of saccharomyces rouxii on oil mill waste waters are then optimized and the results of continuous and batch culture of the chosen yeast phylum are presented. The results of biogas production (anaerobic digestion) and unicellular organism proteins (aerobic fermentation) are analysed.

39450 (IFU-B—07/86) Setting-up of a measuring system and implementation of a test and measuring programme at the biogas plant of the Trummer poultry and pig farm near Gnas. Final report. Reported period: January 1983-December 1985. Padinger, R.; Brunner, N. (Forschungszentrum Graz (Austria). Inst. fuer Umweltforschung). Apr 1986. 40p. (In German). Forschungszentrum Graz (Austria). Inst. fuer Umweltforschung.

The 'Trummer measuring programme' is part of a research project conducted in six biogas plants to work out optimum rating and operational size data for agricultural biogas plants. Under this part project, a test programme is to be established for the 'Trummer' biogas plant, and all essential process parameters are to be recorded in the period of investigation from January 1983 to December 1985. This report presents the results and first evaluations. A detailed evaluation of the results is given in the research project 'Comparative measurements in biogas plants', where the operational results of six biogas plants are contrasted with one another. (orig.) With 14 figs., 7 tabs.

39451 (OGS—031982) Design study for wood gasifier/engine test project. Bircher, K.G.; Sutherland, R.P. (Calgary Univ., Alberta (Canada). Canadian Inst. of Resources Law). Mar 1982. 49p. (CE—01706). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

This report investigates various aspects of coupling wood gasifiers with engine/generators for commercial use (size greater than 1.0 MWe). A brief review of current available gas cleaning and cooling equipment and low heating value engines is presented. Accelerated research into dry methods of scrubbing wood gas will assist greatly in making commercial gasifier/engine combinations a viable alternative. Process design of a gas cleaning system for an 800 kW/sub e/ generator, includes heat and mass balances and instrumentation requirements. A testing program for the gasifier-gas cleaning unit-engine/generator system is outlined. The benfits and drawbacks of upgrading the calorific value of the producer gas by both carbon dioxide removal and oxygen addition are discussed briefly. 10 refs., 10 figs., 12 tabs.

39452 (PNL—6518) Development of biomass gasification to produce substitute fuels. Evans, R.J.; Knight, R.A.; Onischak, M.; Babu, S.P. (Pacific Northwest Lab., Richland, WA (USA)). Mar 1988. Contract AC06-76RL01830. 189p. NTIS, PC A09/MF A01;1; GPO Dep. Order Number DE88008589/JAW.

The development of an efficient pressurized, medium-Btu steam-oxygen-blown fluidized-bed biomass gasification process was conducted. The overall program included initial stages of design-support research before the 12-ton-per-day (TPD) process research unit (PRU) was built. These stages involved the characterization of test-specific biomass species and the characteristics and limits of

fluidization control. Also obtained for the design of the adiabatic PRU was information from studies with bench-scale equipment on the rapid rates of biomass devolatilization and on kinetics of the rate-controlling step of biomass char and steam gasification. The development program culminated with the sucessful operation of the PRU through 19 parametric-variation tests and extended steady-state process-proving tests. the program investigated the effect of gasifier temperature, pressure, biomass throughput rate, steam-to-biomass ratio, type of feedstock, feedstock moisture, and fludized-bed height on gasification performance. A long-duration gasification test of 3 days steady-state operation was conducted with the whole tree chips to indentify long-term effects of fluidized process conditions; to establish gasifier material and energy balances; to determine the possible breakthrough of low concentration organic species; and to evaluate the mechanical performance of the system components. Results indicate that the pressurized fludizied-bed process, can achieve carbon conversions of about 95% with cold gas thermal efficiences about 75% and with low and tar production. New information was collected on the oil and tar fraction, which relate to the process operating conditions and feedstock type. The different feedstocks studied were very similar in elemental compositions, and produced similar product gas compositions, but each has a different distribution and character of the oil and tar fractions. 11 refs., 45 figs., 18 tabs.

39453 **(SV-UG—1988-3) LPG-technology. Energy technology/Gas utilization.** Johansson, S. (Swedish State Power Board, Vaellingby). 11 Dec 1987. 35p. (In Swedish). NTIS (US Sales Only), PC A03/MF A01 . Order Number DE88753755/JAW.

During the last few years the price of LPG has become more and more competitive for other kinds of energy, e.g. oil and natural gas. Many judges consider the low LPG price will exist for a longer period of time. This fact would enable LPG to make a wide appearance in the heating market instead of today being a pronounced industrial fuel. The report tries to present the shaping of a LPG system for space heating. LPG properties, market potential, infra structure, storage, distribution and utilization are considered. Finally legislation, rules and status on LPG installations are surveyed.

39454 **Isolation and characterization of methanogenic bacteria from landfills.** Fielding, E.R.; Archer, D.B.; De Macario, E.C.; Macario, A.J.L. (Institute of Food Research, Norwich (England)). *Applied and Environmental Microbiology;* **54**: No. 3, 835-836(Mar 1988). Contract FG02-84ER13197.

Methanogenic bacteria were isolated from landfill sites in the United Kindgom. Strains of Methanobacterium formicicum, Methanosarcina barkeri, several different immunotypes of Methanobacterium bryantii, and a coccoid methanogen distinct from the reference immunotypes were identified.

39455 **Migration and methanogens - a review of current landfill gas field research at ANL.** Bogner, J.; Torpy, M.; Rose, C.; Vogt, M.; Gartman, D.; Moore, C. (Argonne National Lab., IL (USA);Geotechnics, Inc., Columbus, OH (USA)). pp 189-212 of Energy from landfill gas. Proceedings of a conference jointly sponsored by the UK Department of Energy and the US Department of Energy held at Solihull, UK, 28-31 October 1986. Emberton, J.R.; Emberton, R.F. (eds.). Harwell, England; Harwell Laboratory (1987). (CONF-8610227—). Contract W-31-109-ENG-38.

From United Kingdom/United States conference on energy from landfill gas; Solihull, UK (28 Oct 1986).

Landfill gas recovery research at Argonne National Laboratory (ANL) is focusing on (1) a project studying gas movement through landfill cover materials and (2) a pilot investigation of microbial populations in landfills. The first project is a field investigation begun in 1984 at the Mallard North Landfill, Dupage County, Illinois, where vertical gas pressure and concentration gradients between the top of refuse and the landfill cover are being examined. Preliminary results suggest that changes in soil-gas pressures in the landfill cover and top of refuse closely follow changes in barometric pressure. Measurable concentration gradients exist between the top of refuse and the cover materials, indicating that diffusion is a major mechanism for gas movement, particularly during dry weather when pressure gradients are negligible. The second project is a pilot investigation begun in 1986 on microbial populations in Blackwell Forest Preserve Landfill. The overall objective of this project is to improve understanding of gas production in landfills in order to suggest gas-production management practices.

39456 **Discussion - Session VI.** Walter, D.K. (Department of Energy, Washington, DC (USA)). pp 407-415 of Energy from landfill gas. Proceedings of a conference jointly sponsored by the UK Department of Energy and the US Department of Energy, 28-31 October 1986 United Kingdom. Emberton, J.R.; Emberton, R.F. (eds.). Harwell, England; Harwell Laboratory (1987). (CONF-8610227—).

From United Kingdom/United States conference on energy from landfill gas; Solihull, UK (28 Oct 1986).

Following the session on the future of landfill gas at the 'Energy from Landfill Gas' Conference at Solihull, UK in October 1986, a discussion took place involving twenty participants mainly from the UK and the USA. Topics covered include landfill gas processing and landfill gas instrumentation.

39457 **Summary of current and landfill gas recovery research projects funded by U.S. Dept. of Energy.** Bogner, J.; Antonopoulos, A.A. (Argonne National Lab., IL (USA)). pp 437-447 of Energy from landfill gas. Proceedings of a conference jointly sponsored by the UK Department of Energy and the US Department of Energy, 28-31 October 1986 United Kingdom. Emberton, J.R.; Emberton, R.F. (eds.). Harwell, England; Harwell Laboratory (1987). (CONF-8610227—).

From United Kingdom/United States conference on energy from landfill gas; Solihull, UK (28 Oct 1986).

Summaries are given of five current landfill gas recovery research projects funded by U.S. Dept. of Energy. The titles are 1) variations in gas pressures and concentrations in landfill cover materials, 2) a pilot study of microbial populations in sanitary landfills, 3) the bioconversion of municipal solid waste (MSW) and recovery of organic acids for liquid fuels, 4) the development of improved microbial strains for methane production from MSW and 5) processing high solids waste concentrations by anaerobic digestion for methane production.

0902 Alcohol Fuels

REFER ALSO TO CITATION(S) 39065

39458 **(EUR—11282) Biomethanization of tannery waste: An industrial experiment: Demonstration project.** Aloy, M.; Mermet, R.; Sanejouand, J. (Commission of the European Communities, Luxembourg). 1988. 81p. (EN;FR). NTIS (US Sales Only), PC A05;1; GPO Dep. Order Number DE88012631/JAW.

The tanning and leather dressing industry produces large amounts of waste products including which can be placed in three categories: unrtanned waste, tanned waste, and liquid waste. Both untanned and liquid waste have a high organic content (proteins and fats) and their humidity levels are such that they are readily degraded by methanic fermentation. The results of the experiments confirm the technical feasibility of the project and indicate the economic limits of this type of plant. 14 figs.

39459 **(FRNC-TH—3007) Study of alcohol production from helianthus tuberosus.** Chabbert, N. (Montpellier-2 Univ., 34 (France)). 1984. 120p. (In French). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88753846/JAW.

Results of experiments concerning biomass yield, chemical composition and fermentativity of eight varieties of Helianthus tuberosis are reported and analysed. Effects of crop date, cultivation location and yeast specie (kluyveromyces marxianus, K. fragilis and saccharomyces cerevisiae) are examined. The best yield variety (Violet de Rennes) is optimized in a batch digester and various parameters are studied (airing, agitation, seeding conditions, enzymatic level) for the production of ethanol.

39460 **(FRNC-TH—3008) Contribution to the study of continuous recycle fermentation for the study of continuous recycle fermentation for the production of ethanol from sugar beet juice with saccharomyces cerevisiae.** Boudarel, M.J. (Dijon Univ., 21 (France)). 1984. 150p. (In French). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88753851/JAW.

A study of sugar beet fermentation process is realized at the laboratory scale (pilot of ten liters utile volume) and at the industrial scale (distillery producing 800 hectoliters of ethanol per day). The purpose of this work was to first reproduce the industrial fermentation conditions and second to improve it. A continuous fermentation process with recycle of biomass by a settler, allowed us to obtain at laboratory scale the following functioning conditions with low aeration of wort: consumption of 120 g/l of sucrose in 4 hours of residence time; productivity of 15 g/l/h with a biomass concentration of 50 g/l (the strain was in a flocculant state). This experimental conditions applied to the industrial reactor (two stages of 350 m3 and 260 m3 utile volume) led to an increase of 30% of productivity: treatment of the same beet tonnage in a time 30% smaller than last campaign one.

39461 **(FRNC-TH—3064) Contribution to the study of the fermentation of cellulose hydrolysates by yeasts.** Gonde, P. (Ecole Nationale Superieure d'Agronomie, 34 - Montpellier (France)). 1984. 150p. (In French). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88753847/JAW.

Yeast phyla have been selected for the cellobiose and soluble cellodextrins fermentation. A study of the glucosidase of the Torulopsis Molischiana phylum is presented. Torulopsis M. glucosidase is exocellular with a glycoproteinic nature and its activity spectrum is very large. An improvement of this phylum through genetic engineering is envisaged.

39462 **(FRNC-TH—3085) Study of wood pyrolysis and gasification by thermogravimetry and in a catalyst fluidized bed.** Hemati, M. (Institut National Polytechnique, 31 - Toulouse (France)). 1984. 378p. (In French). NTIS (US Sales Only), PC A17/MF A01. Order Number DE88753850/JAW.

A study of wood wastes pyrolysis and vapour gasification kinetics is presented together with a study of the implementation of sawdust vapour gasification in fluidized beds with sand, activated alumina and a Nickel/alumina catalyst. Based on thermogravimetric results, the limiting factors for pyrolysis and gasification of sawdust and wood sticks are analysed. The Nickel/alumina catalyst allows the production of a gas that is convenient for direct synthesis of methanol.

39463 **(FRNC-TH—3247) Development of an optimal strategy for fermentation process operation with direct digital control (and in real time).** Chaari, K. (Universite de Technologie de Compiegne, 60 (France)). Jul 1987. 154p. (In French). NTIS (US Sales Only), PC A08/MF A01. Order Number DE88753854/JAW.

The aim of this study is the regulation and automatic control of the various physical and chemical parameters affecting the fermentation process: temperature, pH, agitation rate, dissolved oxygen concentration. After a review of the real-time computer technology and control strategy, the different computer-digester interfaces are described. The control algorithms and software developed for the process are presented and results of such controlled fermentation operations are reported. PID regulation and adapted control are used.

39464 **(IFP—35-715) Physiological and kinetics study of the continuous acetonobutylic fermentation.** Barbeau, J.Y. (Institut Francais du Petrole (IFP), 92 - Rueil-Malmaison; Paris-6 Univ., 75 (France)). Jun 1987. 138p. (In French). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88753852/JAW.

The production rate of the acetonobutylic fermentation (acetone, butanol and ethanol) may be improved by continuous fermentation. In this study, the effects of the limiting factors on acid and solvent production are examined for high or low dilution rate, and especially the effects on culture stability and degeneracy are pointed out. A special two-stage system is developed to characterize the phenomenon of degeneracy.

39465 **(Juel-Spez—432) GC/MS-analysis of energy alcohol mixtures.** Hildebrand, U. (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Reaktorbauelemente). Feb 1988. 93p. (In German). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88754007/JAW.

This report provides detailed insight into the composition of complex energy alcohol mixtures. These energy carriers, which might prove highly important in the future, can contain several hundred substances, in particular, apart from alcohols, esters and ketones; minor concentrations, there are also aldehydes, ketales, acetales, ethers, and alkanes. The main objective of the study is the development of a detailed, but timesaving working plan for the qualitative and quantitative analysis of energy alcohol mixtures on the basis of gas-chromatography in connection with mass-spectrometry. The evaluation of such analyses is concentrated on relatively few mass-spectrometric features characteristic of the various substances. The analysis of mass-chromatograms avoids the timeconsuming and sometimes problematic analysis of individual spectra.

39466 **(PB—88-196100/XAB) Integrated biomass energy system for Illinois agriculture. Final report.** Day, D.L.; Steinberg, M.P.; Rodda, E.D.; Hunt, D.R. (Illinois Univ., Urbana (USA). Dept. of Agricultural Engineering). May 1988. 59p. NTIS, PC A04/MF A01.

There is considerable interest in the corn belt region of the USA for producing grain alcohol on farms as liquid fuel for tractors, combines, and trucks used in farming operations. Opportunities appear to exist for fuel-alcohol production on a small scale by individual farmers and local groups. Two major energy consumers in beverage-type alcohol plants are the drying of stillage residues and the fueling the distillation plant. These large energy costs have roused interest in product conservation and fuel-saving methods by using spent stillage as livestock feed and using manure-produced biogas as the process fuel for the alcohol plant. Sludge from the biogas plant also can be distributed onto the cropland to furnish some of the needed crop nutrients.

39467 **(PB—88-197264/XAB) Ethanol: economic and policy tradeoffs.** LeBlanc, M.; Reilly, J.; Kane, S.; Hrubovcak, J.; Hauver, J. (Economic Research Service, Washington, DC (USA). Resources and Technology Div.). Apr 1988. 60p. (USDA/AER—585). NTIS, PC A04/MF A01.

Also available from Supt. of Docs.

Federally supported ethanol use is one alternative for meeting environmental, energy security, and agricultural objectives. Additional expansion of the industry depends on a continuation of current favorable conditions, including extension of the Federal gasoline tax exemption. Under current conditions, ethanol should be able to compete with other additives as an octane enhancer. Expansion of the ethanol industry would increase ethanol's contribution to improving energy security, reducing air-quality problems associated with carbon monoxide, and increasing corn prices. The report provides a basis for assessing the tradeoffs in using ethanol to meet national objectives.

39468 **Solute retention in column liquid chromatography. XI. Exposition of the minor-disturbance method of measurement of the void volume.** Djerki, R.A.; Laub, R.J. (Dept. of Chemistry, Brigham Young Univ., Provo, UT (US)). *Journal of Liquid Chromatography;* **11**: No. 2, 327-332(1988).

The retention volumes corresponding to the disturbance-peaks produced by injection of the components of aqueous blends of organic liquid carriers (reverse-phase stationary packings) have been claimed by some groups to agree to within an experimental error of ca. 1% while, in other instances, discrepancies of slightly greater than this figure have been reported. These results are accounted for in terms of the concentration-based solute partition coefficients K/sub R/. Thus, taking water-methanol mobile phases as an example, the injection of a small amount of either compound is to alter its partition coefficient due, if nothing else, to the resultant change of the composition of the bulk mobile phase. Further, the

respective partition coefficients of the mobile-phase components (hence their retentions) will in all likelihood not be identical. Moreover, for liquid-liquid and reverse-phase LC systems at least, while the magnitude of the change of each of the component K/sub R/ is difficult to forecast, the direction is to be predicated on the finite concentration activity coefficients of the solutes in the blended solvent. For example, because water gives substantially larger negative deviations from Raoult's law with methanol-rich solvents than does methanol, the former is expected to be retained relative to the latter when such blends are employed as LC mobile phases; the converse should then obtain for water-rich carriers. Both situations have been verified experimentally.

39469 **Solute retention in column liquid chromatography. X. Determination of solute infinite-dilution activity coefficients in methanol, water, and their mixtures, by combined gas-liquid and liquid-liquid chromatography.** Djerki, R.A.; Laub, R.J. (Dept. of Chemistry, Brigham Young Univ., Provo, UT (US)). *Journal of Liquid Chromatography;* **11**: No. 3, 585-612(1988).

The Raoult's-law activity coefficients of 3- to 7-carbon aliphatic aldehyde, ketone, ester, and alcohol solutes at infinite dilution in methanol, water, and mixtures of the two and in polydimethysiloxane, all at 293-308 K, have been determined for the first time by appropriate combination of GLC and LLC retention data. The latter data are reported in terms of mole factions, while the former are given in concentration units of molality. However, interpretation of the data is difficult because of the multiplicity of the retention mechanisms. Nevertheless, the combined GLC/LLC technique, which had been applied previously only to pure solvents, is said to offer a number of advantages over static techniques for the determination of solute infinite-dilution activity coefficients with volatile solvents, especially with mixtures of solvents.

0904 Solid Waste And Wood Fuels

REFER ALSO TO CITATION(S) 39046, 40038, 40082, 40083, 40219, 41307

39470 **(FCC—ENFOR031983) Effect of particle size on gross heat of combustion of wood. Final report.** Kryla, J.M. (Forintek Canada Corp., Ottawa, Ontario). Mar 1983. 70p. (CE—01518). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

Three separate experiments were conducted to examine the effects of particle size, drying method, and radial position in stem on the calorific value of wood. In the particle size experiment, wood samples of kiln-dried trembling aspen and white spruce were comminuted, separated to yield 6 particle size classes, then ovendried before testing. In the drying study, freshly cut samples were comminuted to a coarse and a fine fraction, then subjected to either air-drying or ovendrying prior to further analyses. To examine radial variability, earlywood and latewood of various growth rings and inner and outer bark were removed from a 10-year old stem section of hybrid poplar (Populus euramericana (Dode) Guinier, clone I-262), comminuted to less than 250 μm, and ovendried prior to testing. All samples were finally stored over a saturated solution of potassium carbonate to achieve an equilibrium moisture content of 6 to 7% prior to testing. Calorific values of all materials were determined utilizing adiabatic oxygen bomb calorimetry. Lignin, holocellulose, α-cellulose, and extractive contents of the aspen, spruce and hybrid poplar were determined. Selected samples were analyzed for C, H, N, and ash concentrations. Experimental calorific values were compared to theoretical values. Analysis of variance indicated that particle size, drying method, and radial position had small but significant effects upon the measured wood calorific value. To minimize variation, it is recommended that a standardized practice be utilized in the preparation of wood for calorific analyses. 34 refs., 6 refs., 24 tabs.

39471 **(LCI—ENFOR031983) Oil replacement on a pulp mill lime kiln using hog fuel in a Lamb Wet-Cell Burner. Final report.** (Lamb-Cargate Industries Ltd., New Westminster, British Columbia (Canada)). Mar 1983. 129p. (CE—01520). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

The report discusses design, thermal and economic aspects of simultaneously firing a lime kiln with oil and wood waste. The test kiln was of 7 x 200 ft size with a design rating of 53 tonnes/day lime product. Conversion of the kiln to dual wood waste/oil operation necessitated a number of modifications detailed in this report. Representative baseline test data were recorded for oil-fired operation in order to establish the impact of dual-firing. For several levels of oil substitution, wood-heat input was varied with fixed oil flow to determine the effect on lime availability. Computer simulation was used to develop parameter profiles for an insight into the thermal aspects of dual-firing, to predict optimal performance of the test system, and to evaluate performance limits for dual-fuel operation. The simulation indicated that efficient conversion of an existing kiln should include consideration of reduced kiln speed, increased refractory thickness, increased Wet-Cell gas temperature, and reduced ingress air. Optimization of the test kiln was explored assuming reduction in speed and ingress air only. It is recommended that a computer simulation be employed for evaluation of dual-fuel conversions on other kilns. In approaching conversion particular attention should be given to the following areas: fuel moisture content, hot gas duct design, kiln speed, draft fan capacity, and kiln hood and scrubber improvements. The influence of economic factors on kiln conversion was investigated. Based on current world residual oil price, lime kiln conversion is economic, if hog fuel is available for $30/unit or less. 12 refs., 40 figs., 18 tabs.

39472 **(PPRI—081982) Hog fuel drying using vapour recompression. Phase 1. Final report.** Sayegh, N.N.; Azarniouch, M.K. (Pulp and Paper Research Inst. of Canada, Pointe Claire, Quebec). Aug 1982. 48p. (CE—01696). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

The overall heat transfer coefficients for the drying of hog fuel were determined under conditions simulating vapour recompression, i.e. when the heat is supplied by the indirect condensation of low-pressure stem. The tests were carried out both in absence of an intermediate heat transfer medium where the contact between the solids and heat exchange surface was provided by rotating the drying vessel, and with tall oil as a heat trasfer medium with relative motion provided with tall oil as a heat transfer medium with relative motion provided either by again rotating the drying vessel or by cirulating the oil past the solid particles in a stationary drying vessel. The overall heat transfer coefficient decreased rapidly with the decreasing moisture content. In the tests without the oil the average overall heat transfer coefficient between 20 and 60% moisture was 55 W/m/sup 2/K. The average heat transfer coefficients obtained with the stirred-oil tests were somewhat higher, i.e. between 90 and 150 W/m/sup 2/K. The highest coefficients (300 W/m/sup 2/K) were obtained when the oil was circulated through the dryer. For this reason, the next phase of this study will comprise the testing of a continous pilot-scale equipment where the oil/solids mixture will be made to flow co-currently through the heat exchanger. 7 refs., 18 figs.

13 HYDRO ENERGY

REFER ALSO TO CITATION(S) 40075, 40076

39473 **(HQ—021987) Hydro-Quebec development plan 1987-1989, horizon 1996.** (Hydro-Quebec, Montreal (Canada)). Feb 1987. 223p. (MICROLOG—88-02420). Hydro-Quebec, Centre de diffusion, 75, boul. Dorchester ouest, 14e etage, Montreal, P.Q., Canada H2Z 1A4; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

This development plan presents the results of the review conducted over the last few years to clarify Hydro-Quebec's orientations, objectives and strategies and guide them as a group and individually. While covering a 10-year horizon, the plan focuses on the actions to be taken in the next 3 years. In the medium and long term, the plan describes the company's development by several scenarios relating to various paths to be explored. It points out their interaction with the main components of Hydro-Quebec's environment: economic growth, market potential, energy price changes, and interest, inflation and exchange rates. The plan first provides a review of past actions and briefly sketches the external environment. It establishes the reference demand for electricity and discusses Quebec markets, then presents the strategies for developing external markets. It then turns to the operation and development of installations and looks at prospects for developing technology and diversification of activities. Human resource management, financial management and the financial framework for 1987-89 are discussed. The report concludes with a discussion of the impact of the strategies on Hydro-Quebec's partners and explains the economic spinoffs of the development plan. The overall strategy is based on supply optimization and load management integrated with energy marketing activities that are harmonized with pricing, quality of service and resource management policies intended to satisfy the expectations of the company's various partners. This strategy will enable fulfillment of Hydro-Quebec's role as a public utility and amplify its role as an instrument of economic development. 43 figs., 66 tabs.

1301 Resources And Availability

39474 **(CC—EMRER809E) Micro hydro. Vol. 1, a survey of potential micro hydro developments for use by remote communities in British Columbia.** (Crippen Consultants, North Vancouver, British Columbia (Canada)). Oct 1980. 143p. (CE—01188). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

This study attempts to assess the potential for small-scale (10 to 2000 kW) hydroelectric development in remote communities in British Columbia. Data were gathered from existing sources; catalogues of communities were prepared and their average electrical demands estimated. Because of the province's large area, it was divided into 10 separate regions according to major physical/climatological variations and sub-areas within each region, chosen to represent each region, were studied in detail. The proportion of current electrical load which could be replaced by small-scale hydroelectricity was determined, then the same proportion was determined for each region by extrapolation. A total of 443 potential hydro sites were found, the greater number within the 0-50 kW output range. The potential for replacement of installed diesel-electric power by small-scale hydro power was found to be about 54% for the province as a whole, or an average of 14,000 kW of load per remote community. This could mean a fuel savings of 40 million liters per year. Financial and economic analysis procedures are outlined, and detailed assessments of eight sites were made in order to show their feasiblility for development. Another part of this report describes and evaluates currently available generation equipment suitable for small-scale hydroelectric plants. 47 refs., 7 figs., 28 tabs.

1303 Plant Design And Operation

39475 **(DOE/CE/15309—T3) The evaluation of the flash gate board.** Malyevac, D.S.; Leonard, R.G. (Virginia Polytechnic Inst. and State Univ., Blacksburg (USA). Dept. of Mechanical Engineering). May 1988. Contract FG01-87CE15309. 86p. NTIS, PC A05/MF A01 - Order software packages from National Energy Software Center, Argonne National Lab., 9800 South Cass Ave., Argonne, IL 60439. Order documentation without complete package from NTIS.;1; GPO Dep. Order Number DE88011086/JAW.

Report includes 1 diskette designed to run on IBM PC or compatible equipment.

The height of an overflow dam must be designed low enough to prevent the reservoir water level from exceeding a flood plain during flooding conditions. Because of this constraint, much of the available water storage area is wasted and the available pressure head for power generation will be less than maximum during normal conditions. Crest control gates alleviate this problem by providing a variable spillway height. The Flash Gate Board is a passive automatic crest control gate. Its purpose is to regulate flood water while providing increased water pressure for power generation or for additional water storage municipality. The governing equations for the Flash Gate Board system are derived and used to formulate models of system. Computer simulations are used to examine the system response in a variety of operating conditions. The results of these simulations are presented and discussed. The results include an investigation which developed an optimum gate height to maximize the potential of the Flash Gate Board. An experimental model was developed to verify analytical results and to provide additional insight. Conclusions from the study, recommendations for future work, and modifications for a trouble-free design are discussed. 26 refs., 30 figs., 3 tabs.

1306 Environmental Aspects

REFER ALSO TO CITATION(S) 41475, 41482, 41483

39476 **(CONF-880498—1) Dissolved oxygen strategies for hydro relicensing.** Railsback, S.F. (Oak Ridge National Lab., TN (USA)). 1988. Contract AC05-84OR21400. 12p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88008373/JAW.

From National Hydropower Association and EPRI meeting: the future of hydro; Washington, DC, USA (11 Apr 1988).

This report discusses the physical factors controlling DO concentrations, what DO concentrations are low enough to cause concern, how best to monitor and measure DO, how to predict what the effects of project operation on DO concentrations will be, and what measures are available to mitigate DO problems. Each of these topics has been the subject of much study and literature, and the constraints of time and the site-specific nature of many DO problems prevent this discussion from fully addressing all DO considerations at all plants. The objective of the presentation, therefore, is to provide sufficient information for hydro developers to understand potential problems and to undertake the studies required to define and mitigate whatever problems may occur at individual projects. 9 refs., 1 fig.

39477 **(CONF-8806163—1) Assessing cumulative impacts to wintering Bald Eagles and their habitats in western Washington.** Witmer, G.W.; O'Neil, T.A. (Argonne National Lab., IL (USA)). 1988. Contract W-31109-ENG-38. 32p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88011955/JAW.

From Ecosystems management conference: rare species and significant habitats; Syracuse, NY, USA (6 Jun 1988).

Bald Eagles (Haliaeetus leucocephalus) of Washington, the largest wintering population in the lower 48 states, are subject to numerous pressures and impacts from human activites. An evaluative method potential cumulative impacts of multiple hydroelectric development and logging activities on known and potential eagle use areas. Four resource components include food supply, roost sites, mature riparian forest, and disturbance. In addition to actual estimates of losses in food supply (fish biomass in kg) and habitat (km^2) in one river basin, impact levels from 0 (none) to 4 (high) were assigned for each development and for each component based on the impacts anticipated and the estimated value of the site to eagles. Midwinter eagle surveys, aerial photography, topographic and forest stand maps, and site visits were used in the analysis. Impacts were considered additive for all but the disturbance component, which was adjusted for potential synergism between developments. Adjustments were made for mitigation before the impacts were aggregated into a single, dimensionless cumulative impact score. 50 refs., 1 fig., 1 tab.

39478 (DOE/BP—899, pp 37-49) **Sea water challenge test/time of release studies.** Clarke, W.C. (Pacific Biological Station, Nanaimo, British Columbia (Canada)). May 1987. NTIS, PC A12/MF A01. Order Number DE88003264/JAW. (CONF-8505378—).

From Workshop on smoltification and related research; Warm Springs, OR, USA (20 May 1985).

This paper will present some of the authors results with a smolt indicator, the sea water challenge test, and its relationship to the results of a time- and size-of-release experiment. The experiment was conducted in a production hatchery, the Capilano Hatchery, just outside of Vancouver. The author will talk a bit about the sea water challenge test and about the experimental design of the time and size to release studies, and also about the way that these data have been analyzed using response surface analysis. He wants to emphasize this approach more than the conclusions. The response surface analysis is preliminary, since the tag return data are incomplete.

39479 (DOE/BP—899, pp 50-60) **Smolt indices and migration.** Zaugg, W.S. (National Marine Fisheries Service, Cook, WA (USA)). May 1987. NTIS, PC A12/MF A01. Order Number DE88003264/JAW. (CONF-8505378—).

From Workshop on smoltification and related research; Warm Springs, OR, USA (20 May 1985).

First of all, their research has indicated that for both wild and hatchery fish, the migratory period is used as a time for smolt development. Along with this is the second conclusion: that very rarely, if ever, is a complete smolt developed in the hatchery situation. Their third conclusion is that the degree of smolt development influences the rate of migration. It also influences the horizontal positioning in the river, and there have been some thoughts recently about their vertical distribution.

39480 (DOE/BP—899, pp 61-68) **Smolt indices and adult survival.** Ewing, R. (Oregon State Univ., Corvallis (USA)). May 1987. NTIS, PC A12/MF A01. Order Number DE88003264/JAW. (CONF-8505378—).

From Workshop on smoltification and related research; Warm Springs, OR, USA (20 May 1985).

A major question for fish culturists: is the period of smolting the best time to release salmonids for maximum survival to adulthood? Is smolting actually involved in the survival process? Intuitively, it would seem so. Why should the fish go through such complicated changes unless there is some survival advantage? But many recent studies have cast doubt on this relationship. Evidence in recent years suggests that smolting is not the entire story. Upwelling, density of fish in the ocean, food supply, ocean temperature, all can influence survival, and these have little to do with the smolting process. It seems more logical that populations of anadromous fish should have developed an asynchronous timing mechanism that causes fish to reach the ocean over a range of times that bracket the times of optimum ocean conditions. Results are presented from experiments that began as early as 1976, attempting to relate smolt indices to release times that promote survival to adulthood. Test organism is coho salmon released from two Columbia River hatcheries.

39481 (DOE/BP—899, pp 69-79) **Endocrine testing.** Dickhoff, W. (Univ. of Washington, Seattle (USA)). May 1987. NTIS, PC A12/MF A01. Order Number DE88003264/JAW. (CONF-8505378—).

From Workshop on smoltification and related research; Warm Springs, OR, USA (20 May 1985).

The author discusses endocrinology in fish and endocrinology in smoltification, and then more specifically covers some of the work that has been done with thyroid hormones and smoltification of coho salmon. Finally, an attempt is made to apply these endocrine indexing or endocrine measurement methods and some suggestions of future applications of endocrinology in smoltification.

39482 (DOE/BP—899, pp 97-108) **Health measurements.** Smith, L. (Univ. of Washington, Seattle (USA)). May 1987. NTIS, PC A12/MF A01. Order Number DE88003264/JAW. (CONF-8505378—).

From Workshop on smoltification and related research; Warm Springs, OR, USA (20 May 1985).

The author studied the effects of exercise on smolts. Stress resistance appears to be enhanced by exercise. Exercise lowered the threshold for adrenalin production during stress. Adrenalin increased more quickly and decreased faster in exercised than in non-exercised fish. An exercised fish is more like a wild fish than the typical hatchery product. Exercise may also enhance disease resistance. There were some cases of a lower mortality rate, in this case from bacterial kidney disease, in exercised fish than in controls. Vigorous fish are more alert and more active, as well as having increased swimming stamina. Conversion efficiency increases, although sometimes at the cost of slightly increased food consumption. In some cases exercised fish appear to be less concerned about their neighbors, perhaps because they were too busy swimming to be aggressive with the other fish around them.

39483 (DOE/BP—899, pp 120-129) **Lower river release strategies.** Gowan, R. (Anadromous, Inc., Corvallis, OR (USA)). May 1987. NTIS, PC A12/MF A01. Order Number DE88003264/JAW. (CONF-8505378—).

From Workshop on smoltification and related research; Warm Springs, OR, USA (20 May 1985).

The author discusses strategies involved in releasing smolts from hatcheries on the Columbia River Basin. A technique that increases survival of smolts is presented. It involves volitional or self-released fish versus forced-release fish. It is not known why forced-release groups survived better than volitionally released fish, but it might have been related to swamping the local predators.

39484 (DOE/BP—899, pp 130-140) **Ocean release strategies.** McNeil, W. (Oregon Aqua Foods, Inc., Springfield (USA)). May 1987. NTIS, PC A12/MF A01. Order Number DE88003264/JAW. (CONF-8505378—).

From Workshop on smoltification and related research; Warm Springs, OR, USA (20 May 1985).

The ocean is an integral part of the ecosystem of salmon, and it plays as significant a role in survival and production as fresh water does. They face many frustrations in attempting to define variables that they might control in the hatchery production process to improve marine survival. Their coho salmon program focuses on zero age smolts. This program is based on four postulates: (1) ocean mortality is highest and most variable during and shortly after smolts enter the sea; (2) ocean mortality is due largely to predation, but the capacity of smolts to osmoregulate, grow, and resist disease can affect their vulnerability to predation; (3) ocean mortality from predation is density-dependent, but functional responses between mortality and smolt abundance are not well understood; and (4) ocean mortality from predation can be reduced by modifying release strategy and procedures.

39485 (DOE/BP—899, pp 141-156) **Upriver release strategies.** Bjornn, T.C. (Univ. of Idaho, Moscow (USA)). May 1987. NTIS, PC A12/MF A01. Order Number DE88003264/JAW. (CONF-8505378—).

From Workshop on smoltification and related research; Warm Springs, OR, USA (20 May 1985).

Strategies for releasing hatchery salmon and steelhead are being developed because of some major changes that have taken place in the Snake and upper Columbia River basins. In the last 20-30 years, they have gone from salmon and steelhead runs that were mostly produced naturally, to the point where hatchery fish now outnumber wild fish in many drainages. This shift has occurred because of declining natural production and increased hatchery production. The number of chinook salmon redds counted in the Idaho index streams has declined to about one-tenth of former levels. And although the production of hatchery smolts has increased, smolt-adult survival rates for hatchery spring chinook have also declined. Dworshak National Fish Hatchery at the confluence of the North Fork Clearwater and the Clearwater rivers produces about 2.5 million steelhead smolts and 1 million chinook salmon smolts a year. These data are typical of hatchery operations in the Snake river basin in that large numbers of hatchery smolts are being produced to mitigate losses to the natural runs.

39486 (DOE/BP—899, pp 157-169) **Hatchery design for optimum production.** Westers, H. (Michigan Dept. of Natural Resources, Lansing (USA)). May 1987. NTIS, PC A12/MF A01. Order Number DE88003264/JAW. (CONF-8505378—).

From Workshop on smoltification and related research; Warm Springs, OR, USA (20 May 1985).

This paper addresses fish rearing units in terms of optimums relative to rearing space and available flow, selected water quality parameters, and fish size and species. The author will also attempt a rational answer to the question of how much, and what kind of rearing space should be provided for a given flow, water quality, fish size, and species to deliver both quality and quantity. The economic optimum, i.e., the greatest number or weight of fish per unit space, and the product optimum, best quality fish produced under the least amount of stress, must be mutually satisfied. Where is this proper balance of quality and quantity? It seems to be a moving target.

39487 (DOE/BP—899, pp 170-177) **Water supplies.** Warren, J.W. (Fish and Wildlife Service, Vancouver, WA (USA)). May 1987. NTIS, PC A12/MF A01. Order Number DE88003264/JAW. (CONF-8505378—).

From Workshop on smoltification and related research; Warm Springs, OR, USA (20 May 1985).

This study focused on the significant role of the environment in the relationship between the host and the pathogen. The hatchery water supply is a key determinant of smolt health and quality. Disease prevention starts here. Biological criteria should be set for hatchery water supplies, just as they set them for temperature, flow, gas supersaturation, and ammonia levels. The consistent production of quality fish is dependent on a quality environment. If you accept the premise that fish are what they swim in, then they must fully confront the issue of water supply quality before they can be assured of the reliable, consistent production of quality smolts, fully capable of meeting the objectives for which they are reared.

39488 (DOE/BP—899, pp 178-182) **Water quality engineering.** Owsley, D. (Fish and Wildlife Service, Ahsahka, ID (USA)). May 1987. NTIS, PC A12/MF A01. Order Number DE88003264/JAW. (CONF-8505378—).

From Workshop on smoltification and related research; Warm Springs, OR, USA (20 May 1985).

Water quality is one of the major requirements for the production of smolts. Problems are created for fish if water quantity is selected without regard to quality. Managers need to know more and think more about the effects of changes in rearing-water quality. They need to take a more careful look at water quality in the hatcheries. Guidelines are needed to follow, as well as learning how to improve water quality.

39489 (DOE/BP—899, pp 183-194) **Hatchery loading and flow.** Sandercock, F.K. (Canada Fisheries and Oceans, Vancouver, British Columbia). May 1987. NTIS, PC A12/MF A01. Order Number DE88003264/JAW. (CONF-8505378—).

From Workshop on smoltification and related research; Warm Springs, OR, USA (20 May 1985).

The author discusses the loading of fish hatchery ponds with respect to chinook and coho salmon. Chinook was released at a size of 50 to 100 to the pound and coho was generally released at about 17 to the pound. Three successive groups of coho were released from the Big Qualicum hatchery that survived at rates between 25 and 30%.

39490 (DOE/BP—899, pp 207-214) **Hatchery management.** Hopley, C.W. (Washington Dept. of Fisheries, Olympia (USA)). May 1987. NTIS, PC A12/MF A01. Order Number DE88003264/JAW. (CONF-8505378—).

From Workshop on smoltification and related research; Warm Springs, OR, USA (20 May 1985).

Factors affecting the smoltification process are addressed. These factors can be influenced by the way a hatchery is programmed and the way it is operated. Hatchery management really represents the translation of accumulated knowledge into the applied operation of a hatchery. The author discusses the items that are important in the developmental process of smoltification. They include photoperiod, temperature, and environmental factors, and some factors like fish size and genetics.

39491 (OH/RD—87/24/K) **Stewartville GS [Generating Station] new geotechnical instrumentation.** Cragg, C.B. (Ontario Hydro Research Div., Toronto (Canada)). 3 Nov 1987. 26p. (MICROLOG—88-01741). Ontario Hydro Research Division, Editorial Section, 800 Kipling Ave., Toronto, Ont., Canada M8Z 5S4; $10.00 CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

Stewartville Generating Station (Ontario) is a concrete gravity structure with a crest length of 1350 feet and a maximum height of 190 feet. Completed in 1948, this dam was extensively instrumented as part of a major research program. Much of this instrumentation was not maintained after the research program was completed in 1955. A review of the dam's monitoring system recommended that new instrumentation be installed to monitor deformation, to assess performance, to monitor unusual conditions and to provide information for future assessment of performance. This report documents the installation of the survey monuments, normal pendulum and inverse pendulum recommended for the deformation monitoring. Initial readings of the pendulums are also included. 5 refs., 8 figs., 6 tabs.

39492 (OH/RD—87/25/K) **Mountain Chute GS [Generating Station] new geotechnical instrumentation.** Cragg, C.B.H. (Ontario Hydro Research Div., Toronto (Canada)). 7 Oct 1987. 21p. (MICROLOG—88-01742). Ontario Hydro Research Division, Editorial Section, 800 Kipling Ave., Toronto, Ont., Canada M8Z 5S4; $10.00 CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

The Mountain Chute Generating Station (Ontario) main dam is a concrete gravity structure with a crest length of 1400 feet and a maximum height of 172 feet. A review of the dam's monitoring instrumentation recommended that new devices be installed in the main dam to monitor deformation and that existing observation wells be repaired. This report documents the installation of the survey monuments, normal pendulum and inverse pendulum recommended for the deformation monitoring. Initial readings of the pendulums are also included. 3 refs., 6 figs., 5 tabs.

14 SOLAR ENERGY

REFER ALSO TO CITATION(S) 40102, 40104

39493 (IC—87/247) **Silicon solar cell technology state of the art and a proposed double sided cell.** Seddik, M.M. (International Centre for Theoretical Physics, Trieste (Italy)). Aug 1987. 20p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702964/JAW.

A review of the silicon technology state of the art is given. It had been found that single crystal silicon efficiency was limitd to ≅ 20%. The reason was identified to be due to the recombination current loss mechanisms. However, use of new technologies such as back-surface field, surface passivation, double anti-reflection coatings and back-surface illumination demonstrated to achieve higher efficiencies. Experiments were carried out to evaluate the effect of back surfaces illumination on the cell efficiency enhancement. It was found that for single cell, back-surface illumination contribute a 12% increase in efficiency whereas for double cell illumination (back-to-back cells) the improvement was 59% increase in efficiency. A V-shaped flat mirror reflector with optimum angle of 45 deg. to the plane of the cell from both sides achieved the ultimate efficiency performance. Finally, a proposed high current - high efficiency solar cell called "Double Drift" - Double Sided Illumination Cell" was presented. The new structures were in the form of n/sup +/pn/sup +/ or p/sup +/np/sup +/ double junctions. The expected efficiency ranges 50-60% with proper material design, double anti-reflection coatings and V-shaped irregular plane mirror reflector illumination. (author). 43 refs, 4 figs, 7 tabs.

1401 Resources And Availability

39494 (SERI/PR—215-3292) A limited assessment and characterization of the solar radiation energy resources in the Caribbean region. Hulstrom, R.L. (Solar Energy Research Inst., Golden, CO (USA)). Feb 1988. Contract AC02-83CH10093, 170p. NTIS, PC A09/MF A01;1; GPO Dep. Order Number DE88001133/JAW.

The objective of our work was to produce a preliminary assessment and characterization of the Caribbean region (Barbados, Dominican Republic, Guatemala, Jamaica, and Panama) solar radiation energy resources. Such information will be used to estimate the performance of, and identify the most promising applications of, solar heat technologies in the Caribbean region. We expect the solar radiation resources in the Caribbean region to be very location specific. Sunny areas will have an annual direct-beam resource of about 3,000 kWhm{sup {minus 2}} and a global solar radiation resource of about 2,500 kWhm{sup {minus 2}}. Cloud-covered areas will have annual solar radiation resources of about 1,500 kWhm{sup {minus 2} for both the direct-beam and the global solar radiation. Monthly levels of solar radiaion will vary markedly, ranging from an average of 9 to 3 kWhm{sup {minus 2}}day{sup {minus 1}} for the direct-beam and from an average of 7 to 4 kWhm{sup {minus 2}}day{sup {minus 1}} for the global solar radiation. The Caribbean region is comparable to the Great Plains region of the US, in terms of annual solar radiation resources; however, thorough "prospecting" is required to avoid areas having very low amounts of solar radiation.

1403 Economics

REFER ALSO TO CITATION(S) 40084

1405 Solar Energy Conversion

REFER ALSO TO CITATION(S) 39441, 39447, 39448, 39449, 39450, 39451, 39452, 39454, 39455, 39456, 39457, 39459, 39460, 39461, 39462, 39463, 39464, 39472, 39520, 39522, 39539, 40433, 40441, 40533, 40559, 40569, 41415

39485 (BCR—111982) Bin and silo design for biomass materials. Phase 1. Final report. Bundalli, N.; Martinez, O. (B.C. Research, Vancouver (Canada)). Nov 1982. 366p. (CE—01699). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

Flowability tests were carried out on biomass materials (primarily hog fuel, wood chips and sawdust samples as well as several tests on peat, shavings and grain dust) using specially designed test equipment. Critical bin parameters to avoid flow problems were determined from the test results. Results show that mass flow bin design, which is characterized by smooth, steep hopper walls, is necessary to avoid discharge problems. Steel and concrete had very high wall friction against the biomass samples tested, and hence, would require impractically steep hopper walls for mass flow. Ultra high molecular polymer had the lowest wall friction, followed by glass; both of these materials as liners will permit use of practical hopper wall angles. None of the wall materials tested was suitable for mass flow hopper design for peat because of very high wall friction. Minimum mass flow outlet dimensions required under instantaneous consolidation, i.e., continous discharge without rest periods, were practical for the majority of samples tested. Where storage at rest is necessary, external activation to initiate flow is recommended.

39486 (CFS/NFR—NORX242) Biomass equations for ten major tree species of the prairie provinces. Singh, T. (International Association of Hydrogeologists (Canada)). 1982. 35p. (CE—01695). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

Gathering quantitative information on the availability of forest biomass on a sustained basis is a prerequisite to the future use of this resource. At present only very limited data are available for reliably estimating the existing forest biomass in the prairie provinces. The objective of this study was to develop regional biomass equations that eventually could be used to convert a conventional forest inventory to a biomass inventory. The major tree species of the prairie provinces were sampled for aboveground biomass in 1979 and 1980 in order to develop regional biomass equations. Measurements were taken of diameter, height, crown length and width, age, and the biomass weights of subsamples were determined in the laboratory and used to calculate the dry/fresh weight ratios and bark/wood weight ratios for the sampled tree components. Five variables based on diameter and height measurements (D, H, D/sup 2/ H, D/sup 2/, and D/sup 3/) were tested in all combinations as predictors for biomass. A multiple regression model using all five variables provided the best estimates: a polynomial model based on D, D/sup 2/, and D/sup 3/ and a model based on only D/sup 2/H were nearly as good. Equations derived from the three models are presented for each of the 10 tree species. 35 refs., 5 figs., 10 tabs.

39497 (CI—091981) Costs of harvesting aspen stands for energy production. (Ontario Petroleum Inst., Inc., Chatham (Canada)). Sep 1981. 26p. (CE—01697). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

The purpose of this report was to determine production and cost data which would assist resource managers to make rational decisions concerning the utilization of aspen for energy production. Experimentally, the cost per ovendry tonne (ODT) of harvesting aspen undue variable stand conditions was found. Two aspen sites were selected on the Rocky Mountain House Grazing Reserve situated 30 km west of the town of Rimbey, Alberta. Site #1 contained 3.8 ha of 37 year old aspen; site #2 contained 4.9 ha of 58 year old aspen. The aspen was logged and chipped by the full tree harvesting system. Felling was carried out by chain saw and Dika Side Cutter. A Nicholson 22 Complete Tree Utilizer (C.T.U.) was used to chip the aspen. The cost/ODT of harvesting aspen ranged from $47.15 to $70.70. The data indicated that it is unlikely that wood gas derived from full tree aspen chips will prove economically competitive with natural gas until 1983. On an energy equivalent basis wood gas costs $2.44 710/sup 9/J US $1.70/10/sup 9/J for natural gas at the fuel nozzle, a difference of $0.74/10/sup 9/J.

39498 (DOE/ER/13369—3) [Expression and secretion of ligninase cDNAs in Saccharomyces cerevisiae: Progress report. (USDOE, Washington, DC). 1988. Contract FG02-85ER13369. 5p. NTIS, PC A02/MF A01;1; GPO Dep. Order Number DE88011697/JAW.

An analysis of nucleotide sequences of two types of ligninase cDNAs isolated from the basidomycete Phanerochaete chrysosporium, designated CLG4 and CLG5, are presented here. The amino acid sequences of corresponding ligninase proteins, designated LG4 and LG5, respectively, have been deduced from the cDNA sequences. Mature ligninases LG4 and LG5 are preceded by leader sequences containing 28 and 27 amino acids (aa), respectively, and each contains 344 aa residues. The estimated M/sub r/s of mature LG4 and LG5 are 36,540 and 36,607, respectively. Potential N-glycosylation site(s) with the general sequence Asn-X-Thr/Ser are found in both LG4 and LG5. Nucleotide sequence homology between the coding region of CLG4 and CLG5 is 71.5%, whereas the amino acid sequence homology between the two ligninases is 68.5%. The codon usage of ligninases is extremely biased in favor of codons rich in cytosine and guanine. Amino acid sequences of two tryptic peptides of ligninase H8 have exactly matching sequences in ligninase LG5. Also, the sequences of the oligodeoxynucleotide probes, which correspond to the sequences in the tryptic peptides of ligninase H8 and which were used in isolating the ligninase clones from the cDNA library, have exactly matching sequences in CLG5. The experimentally determined N-terminal sequence of purified ligninase H8 is found in the deduced N-terminal amino acid sequence of LG5. These results suggest that CLG5 encodes ligninase H8 and that CLG4 represents a related but different ligninase gene. 7 refs.

39499 **(DOE/ER/13691—T1) Carbon monoxide metabolism by photosynthetic bacteria: Progress report.** Ludden, P.W.; Roberts, G.P. (Wisconsin Univ., Madison (USA)). [1988]. Contract FG02-87ER13691. 4p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE88011569/JAW.

The photosynthetic bacterium, Rhodospirillum rubrum, is capable of converting carbon monoxide to CO_2 and cellular material. Because carbon monoxide is a major industrial pollutant in this country and a product of the biological oxidation of CO is the product of H_2, a major industrial feedstock, this process has practical importance. The oxidation of carbon monoxide to CO_2 by microorganisms is a major component of the carbon monoxide cycle on earth. We have isolated the enzyme responsible for this process from Rhodospirillum rubrum. Carbon monoxide dehydrogenase is an iron - sulfur, nickel- and zinc-containing enzyme. The enzyme is quite stable to heat and amendable to purification, however, it is very labile to oxygen, and all experiments must be conducted anaerobically. We are studying the activities of this enzyme, its regulation and its induction by its substrate carbon monoxide. The enzyme is absent in cells that have not been exposed to carbon monoxide, but cells produce the enzyme at a maximal rate upon exposure to carbon monoxide for as little as ten minutes. Oxygen, a potent and irreversible inhibitor of the enzyme, represses the synthesis of this enzyme. 1 tab.

39500 **(DOE/ER/60612—1) Coupling of primary producers, detritus, decomposer organisms and nitrogen availability during secondary succession: Progress report for period September 28, 1987-September 27, 1988.** Redente, E.F. (Colorado State Univ., Fort Collins (USA). Dept. of Range Science). 1 Jun 1988. Contract FG02-87ER60612. 35p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88011500/JAW.

Secondary succession is a consequence of the interactions among primary producers, decomposers, detritus and abiotic components of the system over time. This study focuses on the interrelationships among above- and below-ground processes involved in semiarid ecosystem development. We found that the addition of nitrogen and phosphorus significantly reduced the production of perennial species while significantly increasing the production of annual and biennial plants. Three years of N addition have altered plant community composition, slowed the rate of secondary succession, and reduced the fungal component, of the microbial community. Early- and late-successional plant species differ in their maintenance of rhizosphere microbial communities. Under nutrient-limited conditions, early-successional species maintain larger microbial biomasses than late-successional species. This strategy may cause early-successional species to be less competitive than late-successional species under nutrient poor conditions because of the need for a greater amount of carbon to be released by early-successional species to maintain a rhizosphere community. Using P/N ratios we have demonstrated that mycorrhizal grasses in the field have enriched relative P nutrition. 52 refs., 2 figs., 3 tabs.

39501 **(DOE/OR/21390—19) Great Lakes Regional Biomass Energy Program: Quarterly report, December 1, 1987-February 29, 1988.** Bancroft, D. (Council of Great Lakes Governors, Inc., Madison, WI (USA)). Jun 1988. Contract FG05-83OR21390. 14p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88011421/JAW.

Stressing near-term biomass feedstock production techniques and conversion processes, the objective of the program is to increase the use of biomass energy by the public and private sectors in the seven state Great Lakes region. States that are in the Great Lakes region include: Illinois, Indiana, Iowa, Michigan, Minnesota, Ohio and Wisconsin. The Great Lakes Regional Biomass Energy Program is divided into three separate operational programs. The first is the State Grant Program, which provides resources to the seven state energy offices in the region to increase their capabilities in biomass energy. State-specific activities and interagency programs are emphasized in the State Grant Program. The second, the Subcontractor Program, involves the letting of subcontracts to private organizations to address regional biomass issues and needs. The third is the In-House Technology Transfer Program in which Council staff develop biomass energy publications and reports. On a programmatic basis, the update of biomass facilities directory was initiated by awarding five of the six states grant agreements and hiring two student interns to work on the project. Two subcontracts were closed out this quarter and a RFP was issued on emissions testing of d-RDF fired boilers.

39502 **(ESA-SP—279, pp vp) SPOT solar array. Box opening mechanisms physical vapor deposition (PVD)-MoS_2: lubricated slides. Functional evaluation.** Patin, J.F.; Cecconi, J.L.; Decramer, L.; Conde, E. (Centre National d'Etudes Spatiales, Toulouse (France)). Dec 1987. NTIS, PC A14/MF A01. (ETN—88-91973; CONF-8709305—).

From 3. European space mechanisms and tribology symposium; Madrid, Spain (30 Sep 1987).

To estimate in-flight safety margins and to delineate the parameters which influence the friction coefficient, the MoS_2 lubrication of the opening mechanism for the stowage box of the SPOT solar array, a set of steel slides restrained by aluminum alloy jumpers, was investigated. Effects of moisture, vacuum, and repeated operations on friction were studied. Measurements on the stowage box slides show low initial dispersions of the friction characteristics; mean reduction of friction effects by 60 percent to be considered for box opening in orbit with respect to the friction values measured in ground tests at 70 percent moisture; and 10 openings as the desirable number of prelaunch operations, with the frictional characteristics thus stabilized still preserved after 24 openings at least.

39503 (ESA-SP—279, pp vp) **Qualification testing of the EUROSTAR Solar Array Drive Mechanism (SADM).** Henderson, I.D. Dec 1987. NTIS, PC A14/MF A01. (ETN—88-91973; CONF-8709305—).

From 3. European space mechanisms and tribology symposium; Madrid, Spain (30 Sep 1987).

The EUROSTAR satellite communication platform solar array drive power ring unit; baseplate shaft and main bearing assembly; motor and gearbox assembly; signal slip-ring unit; and datum sensors are described. Subassembly; nonoperational; functional; vibration; thermal vacuum; and accelerated life tests are summarized.

39504 **(EUR—11138-EN) Biotechnology action programme BAP 1985-1989. Progress report 1987. Vol. 1. An overview.** Magnien, E. (ed.). (Commission of the European Communities, Luxembourg. Directorate General Telecommunications, Information Industries and Innovation; Commission of the European Communities, Brussels (Belgium)). 1987. 154p. Commission of the European Communities, Luxembourg. Office for Official Publications of the European Communities.

Biological Sciences.

The multiannual research and training programme of the European Economic Community in the field of biotechnology is presented. It deals with two essential tasks, namely the establishment of a supportive infrastructure for biotechnology research and development in Europe as well as the exploitation by industry and agriculture of the materials and methods originating from modern biology. (EF)

39505 **(FRNC-TH—3005) Utilization of salt ammoniacates in fluidized beds in energy conversion thermochemical systems.** Romero, J. (Institut National Polytechnique, 38 - Grenoble (France)). 1984. 240p. (In French). NTIS (US Sales Only), PC A11/MF A01. Order Number DE88753849/JAW.

A thermochemical storage device based on strontium chlorides and calcium chloride ammines thermal decomposition balances has been designed and developed. The operating conditions have been optimized through experiments. The heat exchange ratio for this fluidized bed storage device is twenty times greater than the heat exchange ratio measured with equivalent devices with fixed beds. The solid grain dimension irreversible modification seems to be responsible of the process irreversibility of the process.

39506 **(GD—ENFOR061983) Evaluation of potential interactions between forest biomass production and Canadian wildlife. Final report.** Coulombe, R.; Lemay, A.B. (Le Groupe Dyrade Ltd., Quebec City (Canada)). Jun 1983. 305p. (CE—01522). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

Forest management for biomass production can be undertaken in all provinces of Canada. Raw material can be extracted either from sawmills, logged areas, silvicultural treatments or short-rotation intensive culture. All forests are suitable habitats for wildlife. However, some species (e.g. woodland caribou, lynx, marten, owl) are extremely dependant on mature forests. Logging these forests generally contributes to reduction of habitats and thus populations. Management of second growth forests should take into consideration these species by extending rotations so part of the forests will serve the species. Removal of snags and downed logs to increase amount of raw material will contribute to reduced habitats of, for instance, tree-nesting birds. As these aspects have not been intensively studied within the Canadian forest regions, interactions can hardly be specified. Studies are recommended to analyse the overall problems and define measures to prevent detrimental effects. Other species (rare, threatened or endangered) will need specific attention and precaution while managing forests. Some are highly sensitive to noise and human disturbance (e.g. whooping crane, white pelican, peregrine falcon), others are very sensitive to harassment. Increased human presence within managed forests will necessitate more educational programs to prevent detrimental effects. Some species of reptiles, amphibians and fish are so poorly documented that only basic studies of the biology, ecology and distribution will permit to identify and evaluate interactions with these new forestry concepts. 289 refs., 19 figs., 36 tabs.

39507 **(INPE—4248-PRE/1121) Solar cell experiment on the first satellite of the Brazilian complete space mission.** Nubile, P.; Veissid, N.; Beloto, A.F.; Perondi, L.F.; Torres-filho, A. (Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil)). Jul 1987. 10p. (CONF-8707154—). NTIS, PC A02/MF A01.

From 8. Brazilian congress of vacuum applications in industry and science; Rio de Janeiro, Brazil (22 Jul 1987).

The first data collection satellite of the Brazilian Complete Space Mission (MECB), whose launching is anticipated for the first half of 1989, carries on board the Solar Cell Experiment (SCE) which is intended to demonstrate the capacity of the National Research Laboratory in the production of space quality solar cells and solar panels. The SCE consists of the use of a 61 x 61 millimeter area, available on one of 8 lateral panels on the satellite in an arrangement of three arrays of two 20 x 19 millimeter solar cells in series, a total of six solar cells. Each array is connected to a fixed charge resistor, forcing the operation of the cells at the point of open circuit, short-circuit, and maximum potential, which permits the observation of the degradation of the parameters of interest (V sub OC, I sub SC, I sub mp, and V sub mp) with the thermal cycles and radiation damage during the mission.

39508 **(LBL—25186) Structure and function of the manganese complex involved in photosynthetic oxygen evolution determined by x-ray adsorption spectroscopy and electron paramagnetic resonance spectroscopy.** Guiles, R.D. (Lawrence Berkeley Lab., CA (USA)). Apr 1988. Contract AC03-76SF00098. 274p. NTIS, PC A12/MF A01;1; GPO Dep. Order Number DE88010360/JAW.

Water is the terminal electron donor in the linear light-driven electron transport chain used by higher plants, cyanobacteria and green algae to fix carbon dioxide. The involvement of a membrane-bound manganese-containing protein complex has been demonstrated at the site of water oxidation within the photosystem II (PSII) reaction center. The photosynthetic oxidation of water to molecular oxygen is believed to involve intermediate S-states (S_0{hor←ellipsis}S_4), of the oxygen evolving complex (OEC). The use of multiline EPR signal associated with Mn and assigned to the S_2 state has greatly facilitated structural characterization of the OEC. This thesis contains a description of methods used to cryogenically stabilize PSII preparations suitable for x-ray absorption spectroscopy in the S_1, S_2 and S_0 states as well as a state induced by hydroxylamine resembling the S_0 state of the OEC. Studies of the Mn K-edges of PSII preparations indicate that a light-induced oxidation of Mn occurring during the $S_1 \rightarrow S_2$ state transition corresponds to a formal valence change from Mn(III) to Mn(IV). An analysis of the extended x-ray absorption fine structure (EXAFS) of the Mn complex within PSII preparations poised in the S_1, S_2, S_0 and hydroxylamine-induced S_0 states indicates that the four manganese present are organized as two di-μ-oxo bridged binuclear manganese complexes. An essential component of the analysis of the EXAFS was a parallel analysis of a set of crystallographically characterized multinuclear μ-oxo bridged manganese complexes. Based on conclusions drawn from the analysis of the Mn K-edge and EXAFS of PSII preparations cryogenically stabilized in the S-states described above, a model for the mechanism of photosynthetic water oxidation is presented. 274 refs., 46 figs., 17 tabs.

39509 **(NBNRE/FM—ENFOR081983) Trial conversion of conventional inventory data to biomass data in New Brunswick. Final report.** Fowler, D. (New Brunswick Dept. of Natural Resources and Energy, Fredericton (Canada)). Aug 1983. 59p. (CE—01517). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

Biomass equations developed by the Canadian Forestry Services for 17 Maritime tree species were incorporated into New Brunswick's existing volume inventory handling computer software. This software was then used to provide biomass estimates for a pilot area of approximately 1.24 million hectares in the northwest corner of the province. The software developed for this pilot project will be used in part to convert the New Brunswick volumetric inventory to a biomass inventory. 6 refs., 3 figs., 15 tabs.

39510 **(NBU/FR—ENFORMX147) Tree biomass equations for young plantation-grown red pine (Pinus resinosa) in the Maritime lowlands ecoregion.** Methven, I.R. (New Brunswick Univ., Fredericton (Canada). Dept. of Forest Resources). 1983. 15p. (CE—01516). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

Prediction equations were developed for young (1-20 years) plantation-grown red pine (Pinus resinosa) in the lower Maritime provinces of Canada, based on dimensional relations. The estimator varied according to age class and biomass component but the square of the diameter at breast height was the best overall estimator. Biomass yields per hectare from the plantations sampled tended to be lower than those reported in the literature. Reasons for this are discussed. 35 refs., 3 figs., 9 tabs.

39511 **(NSLF/FRPM—ENFOR031983) Trial conversion of conventional inventory data to biomass data in Nova Scotia. Final report.** MacQuarrie, G.D. (Nova Scotia Dept. of Lands and Forests, Truro (Canada). Forests Resources Planning and Mensuration Div.). Mar 1983. 34p. (CE—01521). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

Single tree equations are available for estimating the biomass components for some species in the Maritimes. This pilot study has developed techniques to demonstrate two methods to estimate regional biomass inventory using conventional forest inventory data available in Nova Scotia. Measurements from permanent sample plots and from multistage temporary sample plots are transformed using the available biomass equations. Actual results for two counties, Cumberland and Picon, are provided, and details of missing data are discussed. 8 refs., 3 figs., 18 tabs.

39512 **(PB—88-190681/XAB) Predicting crown weight and bole volume of five western hardwoods. Forest Service general technical report.** Snell, J.A.K.; Little, S.N. (Forest Service, Portland, OR (USA). Pacific Northwest Research Station). Mar 1983. 42p. (FSGTR-PNW—151). NTIS, PC A03/MF A01.

See also PB—88-117874.

Regression equations are presented for estimating biomass of five western hardwoods: red alder (Alnus rubra), giant chinkapin (Castanopsis chrysophylla), big leaf maple (Acer macrophyllum), Pacific madrone (Arbutus memziesii), and tan oak (Lithocarpus densiflorus). Estimators are given for total crown biomass, cumulative proportions for separating crown weight into foliage and four timelag fuel diameter classes, bark weight, and bole volume (inside bark) to any specified top diameter. With one exception, the equation uses diameter at breast height as the only independent variable.

39513 (PB—88-191770/XAB) Silviculture of ponderosa pine in the Pacific Northwest: the state of our knowledge. Forest Service general technical report. Barrett, J.W. (Forest Service, Portland, OR (USA). Pacific Northwest Research Station). Dec 1979. 111p. (FSGTR-PNW—97). NTIS, PC A06/MF A01.

Also available from Supt. of Docs.

The silviculture of ponderosa pine in the Pacific Northwest States of Washington and Oregon is described. The timber resource, growth, and value are discussed first, followed by damaging agents, management, and silviculture. Relevant literature is presented along with observations, experience, and results of unpublished work. Research needs for the future are also proposed.

39514 (PB—88-199237/XAB) Six-year growth of Eucalyptus saligna plantings as affected by nitrogen and phosphorus fertilizer. Forest Service research paper (Final). Whitesell, C.D.; DeBell, D.S.; Schubert, T.H. (Forest Service, Berkeley, CA (USA). Pacific Southwest Forest and Range Experiment Station). Oct 1987. 11p. (FSRP-PSW—188). NTIS, PC A03/MF A01.

Growth responses of Eucalyptus saligna to nitrogen (N) and phosphorus (P) fertilizers were assessed in bioenergy plantations on abandoned sugarcane land in Hawaii. Fertilizers were applied three times (0.6, and 15 months after planting) in a factorial design with four dosages each of N(0, 25, 50, and 75 g urea per tree) and P(0, 30, 60, and 90 g triple superphosphate per tree). Phosphorus and the N x P interaction had little effect on tree growth. Effects of N, however, were dramatic during the first year, and benefits were sustained through 6 years. Effects of N on height growth and diameter growth dropped markedly during the third year and thereafter. Bioenergy plantations of E. saligna established on similar sites and soils will benefit from high dosages of N fertilizer and presumably from repeated applications.

39515 (PB—88-210612/XAB) Enzymological and genetic studies of one-carbon reactions in methanogenic bacteria. Annual report, January 1987-December 1987. Ferry, J.G. (Virginia Polytechnic Inst. and State Univ., Blacksburg (USA)). Jan 1988. 101p. NTIS, PC A06/MF A01.

This project is aimed at determining the biochemical mechanisms of one-carbon reactions and the genetic-control mechanisms of methanogenesis, an important step in the conversion of biomass to methane. Two enzymes (acetate kinase and a ferredoxin) were purified from methanogenic bacteria. These results extend the understanding of how methanogens regulate metabolism and identify a control point that could be exploited to improve the rates of acetate conversion to methane. A plasmid DNA from methanogens was purified and characterized which could potentially provide a tool for genetic engineering to provide new methods to further study steps in the pathway.

39516 (SERI/STR—211-3218) MOCVD techniques for CdTe solar cells: Final report, 15 February 1985-1 April 1987. Schafer, D.E. (Honeywell Physical Sciences Center, Bloomington, MN (USA)). Feb 1988. Contract AC02-83CH10093. 49p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88001163/JAW.

This report summarizes the application of metal-organic chemical vapor deposition (MOCVD) film growth to two aspects of CdTe/ITO solar cell fabrication: (1) the growth of large-area CdTe films on ITO, and (2) the formation of low-resistance ohmic contacts to p-type CdTe. A reduced-temperature MOCVD process was developed for the deposition of CdTe films in order to minimize the potential for chemical and physical changes in the ITO layer during cell fabrication of ohmic contacts (opaque and long wavelength transparent, respectively) to the CdTe layer of the photovoltaic structure. This report details the MOCVD reactor geometries and process parameters used in the development of the CdTe, HgTe, and ZnTe layer growth, as well as the results of C-V analysis of the carrier concentration in the MOCVD CdTe layers and resistance characteristics of various interfaces formed by CdTe, HgTe, and ZnTe.

39517 (WU—ENFOR101983) Electrical discharge flash pyrolysis of biomass. Final report. Sivell, A.N.; Beckmans, J.M. (Western Ontario Univ., London (Canada)). Oct 1983. 67p. (CE—01523). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

A study of electrical discharge flash pyrolysis of biomass has been completed. The experiments consisted of discharging a high voltage capacitor (320 joules) through biomass samples held between two electrodes. Pellet samples made from graphite and cellulose were not pyrolysed by the discharge. The electrical energy could not be coupled to the sample to achieve any measureable pyrolysis. Conductive string samples showed similar results. Discharge through a thin wire (.0006 in) pyrolyzed the biomass layer on the surface of the wire. Gas analysis of the pyrolysis gases showed the mixture contained mainly hydrogen and carbon monoxide with low concentrations of carbon dioxide and hydrocarbons. The effects of sample constitution (lignin, birch flour, and cellulose), sample mass, and initial water content and the composition of the gas surrounding the sample were determined. It was discovered that the presence of a glass containment tube, open at both ends, around the sample produced a very substantial increase in yield of gases. No commercial process for producing useful gases from biomass by electrical discharge suggests itself as a result of this study. 6 refs., 11 figs., 21 tabs.

39518 Current U.S. research in methanogenesis microbiology. Antonopoulos, A.A. (Argonne National Lab., IL (USA)). pp 164-175 of Energy from landfill gas. Proceedings of a conference jointly sponsored by the UK Department of Energy and the US Department of Energy held at Solihull, UK, 28-31 October 1986. Emberton, J.R.; Emberton, R.F. (eds.). Harwell, England; Harwell Laboratory (1987). (CONF-8610227—). Contract W-31-109-ENG-38.

From United Kingdom/United States conference on energy from landfill gas; Solihull, UK (28 Oct 1986).

The United States Department of Energy (DOE) Energy from Municipal Waste Program (MSW) supports research to develop new technologies to effectively utilize MSW for methane and other fuels production. The current research on bioconversion of MSW focuses on identifying methods to improve the effectiveness of microbial populations to enhance energy production from waste organic matter. Four of the DOE-supported projects directly related to methanogenesis microbiology are presented. These study the effect of molecular hydrogen on acetate degradation by methanogens, the effect of trace metals on methanogenesis and control of sulphate reducing bacteria, enzymatic and genetic studies of methanobacteria and the bioconversion of MSW and recovery of organic acids for liquid fuels production.

1406 Photovoltaic Power Systems

REFER ALSO TO CITATION(S) 39991, 40259, 41607

39519 (DOE/CH—10093-21) National Photovoltaics Program: 1987 program review. (Solar Energy Research Inst., Golden, CO (USA)). Apr 1988. Contract AC02-83CH10093. 15p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88001148/JAW.

A number of photovoltaic systems, components and applications are highlighted under the national program.

39520 **(DOE/PHV—88/1) Photovoltaic Energy: Electricity from Sunlight: A current awareness bulletin.** Williams, L.E. (ed.). (USDOE Office of Scientific and Technical Information, Oak Ridge, TN). Jan 1988. 47p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88008289/JAW..

Photovoltaic Energy: Electricity from Sunlight (PHV) announces on a bi-monthly basis the current worldwide information available on all aspects of photovoltaic amorphous technology, polycrystalline thin films, gallium arsenide, crystalline silicon, concentrator technology, and systems research. This publication contains the abstracts of DOE reports, journal articles, conference papers, patents, theses, and monographs added to the Energy Data Base (EDB) during the past two months. Also included are US information obtained through acquisition programs or interagency agreements and international information obtained through the International Energy Agency's Energy Technology Data Exchange or government-to-government agreements.

39521 **(N—88-21254) Power system for production, construction, life support and operations in space.** Sovie, R.J. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). 1988. 16p. (NASA-TM—100838; E—4026; NAS—1.15:100838; CONF-880843—). NTIS, PC A03/MF A01.

From SPACE conference; Albuquerque, NM, USA (29 Aug 1988).

As one looks to man's future in space it becomes obvious that unprecedented amounts of power are required for the exploration, colonization, and exploitation of space. Activities envisioned include interplanetary travel and LEO to GEO transport using electric propulsion, Earth and lunar observatories, advance space stations, free-flying manufacturing platforms, communications platforms, and eventually evolutionary lunar and Mars bases. These latter bases would start as camps with modest power requirements (kWes) and evolve to large bases as manufacturing, food production, and life support materials are developed from lunar raw materials. These latter activities require very robust power supplies (MWes). The advanced power system technologies being pursued by NASA to fulfill these future needs are described. Technologies discussed will include nuclear, photovoltaic, and solar dynamic space power systems, including energy storage, power conditioning, power transmission, and thermal management. The state-of-the-art and gains to be made by technology advancements will be discussed. Mission requirements for a variety of applications (LEO, GEO, lunar, and Martian) will be treated, and data for power systems ranging from a few kilowatts to megawatt power systems will be represented. In addition the space power technologies being initiated under NASA's new Civilian Space Technology Initiative (CSTI) and Space Leadership Planning Group Activities will be discussed.

39522 **(SAND—87-7023) Stand-alone photovoltaic systems: A handbook of recommended design practices.** (Sandia National Labs., Albuquerque, NM (USA); New Mexico Solar Energy Inst., Las Cruces (USA)). Apr 1988. Contract AC04-76DP00789. 415p. NTIS, PC A18. Order Number DE88012512/JAW.

This document presents recommended design practices for stand-alone photovoltaic systems. It discusses system-level tradeoffs necessary for any application. It presents a system sizing method that can be completed without access to a computer. Instructions and blank worksheets are provided in an appendix. Fifteen specific examples of PV systems designed to meet a wide range of applications are presented. Each example is based on an installed system and includes hardware specifications, installation description, and cost information. Before starting the design for a PV system, the reader is encouraged to consult manufacturers and suppliers of solar equipment for the latest product specifications.

1407 Solar Thermal Power Systems

REFER ALSO TO CITATION(S) 39521, 39554, 40305

39523 **(DOE/STT—88/1) Solar Thermal Energy Technology: A current awareness bulletin.** Smith, L.; Steele, B.C. (eds.). (USDOE Office of Scientific and Technical Information, Oak Ridge, TN). Jan-Feb 1988. 14p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88008294/JAW.

This publication contains the abstracts of DOE reports, journal articles, conference papers, patents, theses, and monographs added to the Energy Data Base (EDB) during the past two months. Also included are US information obtained through acquisition programs or interagency agreements and international information obtained through the International Energy Agency's Energy Technology Data Exchange or government-to-government agreements.

39524 **(N—88-21249) Advanced sensible heat solar receiver for space power.** Bennett, T.J.; Lacy, D.E. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). 1988. 12p. (NASA-TM—100847; E—4008; NAS—1.15:100847; CONF-880702—). NTIS, PC A03/MF A01.

From 23. intersociety energy conversion engineering conference; Denver, CO, USA (31 Jul 1988).

NASA Lewis, through in-house efforts, has begun a study to generate a conceptual design of a sensible heat solar receiver and to determine the feasibility of such a system for space power applications. The sensible heat solar receiver generated in this study uses pure lithium as the thermal storage medium and was designed for a 7 kWe Brayton (PCS) operating at 1100 K. The receiver consists of two stages interconnected via temperature sensing variable conductance sodium heat pipes. The lithium is contained within a niobium vessel and the outer shell of the receiver is constructed of third generation rigid, fibrous ceramic insulation material. Reradiation losses are controlled with niobium and aluminum shields. By nature of design, the sensible heat receiver generated in this study is comparable in both size and mass to a latent heat system of similar thermal capacitance. The heat receiver design and thermal analysis was conducted through the combined use of PATRAN, SINDA, TRASYS, and NASTRAN software packages.

39525 **(SAND—88-0118C) Advanced molten salt receiver test options.** Tyner, C.E. (Sandia National Labs., Albuquerque, NM (USA)). 1988. Contract AC04-76DP00789. 10p. (CONF-880655—1). NTIS, PC A02/MF A01;1; GPO Dep. Order Number DE88011548/JAW.

From 4. international symposium on research, development and applications of solar thermal technology; Santa Fe, NM, USA (13 Jun 1988).

Recent solar central receiver (SCR) studies have identified further receiver testing and scale-up as key issues for risk reduction and commercialization of SCR technology. To identify possibilities for this testing, we have investigated a number of options for evaluating advanced molten salt receivers or receiver panels at existing or upgraded facilities. Those options include salt-in-tube and direct absorption receiver (DAR) configurations optimized for performance, scale-up, or receiver-life testing. Potential test facilities analyzed include the Central Receiver Test Facility (CRTF) and Solar One (modified for molten salt use, either as a 40-MW/sub t/ surround-field or as a 25-MW/sub t/ north-field). At its current size, the CRTF could be used for a 5-MW/sub t/ salt-in-tube receiver panel test. Expanded to 10 MW/sub t/, the facility would become suitable for either a high-flux DAR panel or a scaled-up salt-in-tube panel. Using the north-field of Solar One would allow testing both salt-in-tube and DAR panels up to 25 MW/sub t/ and about 60% of the length of panels in a 100-MW/sub e/ (468-MW/sub t/ peak) commercial SCR power plant. Finally, using Solar One in its full surround-field configuration would allow testing of a scaled, external-cylinder receiver 30% the height of that in the same commercial plant.

39526 (SAND—88-0321) Performance of the Solar One power plant as simulated by the SOLERGY computer code. Alpert, Daniel J.; Kolb, Gregory J. (Sandia National Labs., Albuquerque, NM (USA)). Apr 1988. Contract AC04-76DP00789. 92p. NTIS, PC A05/MF A01;1; GPO Dep. Order Number DE88012750/JAW.

The SOLERGY computer code is a valuable tool for the commercialization of solar central receiver power plants. SOLERGY predicts the annual energy produced by a plant and can be used in design optimization studies to evaluate alternative plant designs or operating strategies. This report validates SOLERGY by comparing its prediction of annual energy with the actual performance of the Solar One power plant during 1985. SOLERGY reliably estimates annual energy production, provided good estimates of user-supplied parameters on the plant's operation are available. The code's predictions of plant performance on clear days agree well with the actual performance. However, the code tends to overestimate the performance on partly cloudy days because of the use of 15-minute average insolation data and its failure to account for actions taken by the plant's operators. Possible applications of the code and a discussion of the sensitivity of results to uncertainty in key input parameters are presented. 28 refs., 28 figs., 19 tabs.

1408 Ocean Energy Systems

39527 Effect of marine microbiofouling and countermeasures on corrosion of some aluminum alloys under OTEC heat exchanger conditions. Larsen-Basse, J.; Jain, S. Houston, TX; National Assoc. of Corrosion Engineers (1987). 10p. (CONF-870314—). National Assoc. of Corrosion Engineers, P.O. Box 218340, Houston, TX 77218.

From Corrosion '87; San Francisco, CA, USA (9 Mar 1987).

Aluminum alloys 5052, 3004 and Alclad (7072) 3003 and 3004 have been exposed to warm Hawaiian surface sea water and cold, deep ocean water under simulated OTEC heat exchanger conditions for over three years. Flow velocity has been maintained at 1.85 m/s (6 fps) through loops of tubular samples which also contained heat transfer monitors. Development of heat transfer resistance due to biofouling was monitored and biofouling and corrosion rates were determined. Loops were operated under the following conditions: cold water - no countermeasures; warm water - free fouling for 25-40 days, then brushing clean; chlorinated on an intermittent schedule to maintain zero heat transfer resistance; and mechanically cleaned with sponge rubber balls on a daily schedule. It was found that the corrosion film does provide some protection of biofouling which becomes embedded in it, but that neither biofilm, nor chlorination, nor intermittent brushing had any effects on the corrosion rate. Daily mechanical cleaning, on the other hand, caused severe erosion-corrosion of all alloys tested, except alloy 5052.

1409 Solar Thermal Utilization

REFER ALSO TO CITATION(S) 39522, 40127, 40130, 40143

39528 (DE—SIM4) SOLAR-C: computer program for the design of solar energy systems. Vol. 1. System specification guide. (Davis Engineering Ltd., Ottawa, Ontario (Canada)). Nov 1982. 34p. (CE—01671). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

SOLAR-C is a computer program which simulates solar energy systems in real time or some multiple of real time, thereby allowing control schemes and various system configurations to be investigated. Hour-by-hour weather data is input to the program and performance of a system over any time period up to a year can be determined. The detailed performance of control schemes can also be obtained by using minute-by-minute data. SOLAR-C is a hybrid computer program that makes use of both a digital and an analog computer. It was developed on the EAI Pacer 100 System at the National Research Council in Ottawa. This report outlines the system specifications. Two other volumes, "Program Design Manual" and "Operating Manual", are available on loan from the Solar Energy Program for users of the system. 9 figs., 5 tabs.

39529 (DSMA—10411008) The potential thermal performance and economic viability of solar utilities in Canada. (Dilworth, Secord, Meagher and Associates Ltd., Toronto, Ontario (Canada)). 4 Jan 1979. 227p. (CE—01581). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

This study was undertaken to provide a thermal and economic performance data baseline for solar utilities designed to operate in the Canadian climate. This report presents a summary of the findings of the study and provides details on the methdology used. Solar utilities are defined here as utilities providing 100 percent of the space heating requirements of a group of dwellings, by collecting solar radiation throughout the year, storing thermal energy on an annual basis and supplying it seasonally as required. The study has also considered district heating utilities which are defined as meeting the same requirement from some combination of solar and other energy sources. Computer runs, each simulating utility operation for two years, have been used to establish the configuration required to supply all of the required heat load and the sensitivity of utility performance and capital cost to the many design parameters, geographical locations, size of installation and potential technological improvements. Baseline configurations, for four Canadian climatic conditions, were selected from these sensitivity studies and were subjected to economic evaluation. Salient results from the technical evaluation include the following. As expected, location has a significant impact on performance and cost. Over the range of capacities studied, efficiency increases and unit cost decreases as the scale of the utility is enlarged. The economic evaluation shows that viability, based on present technology and costs, is still some way off, but the longer term prospects are encouraging. It is concluded from the study that the seasonal storage solar utility is peculiarly appropriate to the Canadian latitude and climate. 25 refs., 59 figs., 30 tabs.

39530 (EUR—10683, pp I.1-I.7) Section 1: Overview of passive solar architectural principles. 1986. Commission of the European Communities, Luxembourg. Office for Official Publications of the European Communities.

In European passive solar handbook. Basic principles and concepts for passive solar architecture. Preliminary edition.

A heavily illustrated survey informs about architectural aspects relevant to passive solar heating systems. Descriptions of bioclimatic building fronts focus on the thermal behaviour of the latter and place special emphasis on solar apertures, heat storage and heated space. Reference is made to solar building materials and suitable building designs as well as to temperature swings and climatic influences. Passive solar heating concepts are presented with emphasis both on thermal and organizational requirements and statements as to the maximum thermal comfort of the heated space concerned. (HWJ).

39531 (EUR—10683, pp 5.1-5.42) Section 5: Passive solar design strategies and tools. 1986. Commission of the European Communities, Luxembourg. Office for Official Publications of the European Communities.

In European passive solar handbook. Basic principles and concepts for passive solar architecture. Preliminary edition.

Optimal passive solar concepts rely on adequate passive solar design strategies and tools. Along with numerous diagrams a survey facilitates access to graphical tools such as shading analyses (position of the sun relative to planes, shading, computer-aided graphical analyses), and deals with daylight calculations (sky component, reflection component, total daylight factor). A survey and selection of thermal design tools (desk calculator and manual methods, practical calculation examples, correlation and simulation methods) is followed by cost-benefit analyses (cost per unit of energy saved, life-cycle costing). According to the conclusion, cost-benefit analyses should not be considered exact and complete but be serving as a vehicle of decision making. (HWJ).

39532 (EUR—10683, pp 6.1-6.49) Section 6: Case studies. 1986. Commission of the European Communities, Luxembourg. Office for Official Publications of the European Communities.

In European passive solar handbook. Basic principles and concepts for passive solar architecture. Preliminary edition.

Numerous illustrated examples demonstrate the appropriate architectural and technical application of passive solar designs in recently realized residential buildings. The location of 17 solar building is shown on a map of Europe. Access is given to the structural and to essential solar data of the buildings presented. The data referred to include solar radiation and temperature values, data on floor areas, glasing, heat storage, collector systems, orientation of buildings, roof and wall coverings, attached greenhouses, verandas, surroundings, sectional drawings of buildings (multi-storey buildings) and materials. (HWJ).

39533 **(EUR—11275) The monitoring of solar hot-water heating systems in two sheltered-housing schemes: Demonstration project.** Jesch, L. (Commission of the European Communities, Luxembourg). 1988. 79p. NTIS (US Sales Only), PC A05;1; GPO Dep. Order Number DE88012632/JAW.

The aim of the project was to find and compare the thermal performance of two solar water preheat systems which shared proximity of sites, urban environment and British weather conditions, but differed in design principles and used different components. Monitoring the durability, reliability and social usefulness of the systems was also part of the project. Although it was a demonstration project which followed previous research and development phases it was found that the performance of demonstration and monitoring brought to the surface some new aspects of the design and of the installation which were best investigated right away. To follow these new aspects much research was carried out and therefore it was recognized from the outset that the cost of the installation and operation will be higher than that of a straightforward commercial system. The main benefit of the project was to teach investors, designers, operators and users what the best choices were regarding: design details, materials used, control systems and strategies. Another benefit was the gaining of experience in monitoring complex systems: learning about instrumentation, data processing, information technology and the way the information could be shared with others. An unexpected additional benefit was the understanding gained of how mechanical systems and people interacted which is vital in the design of good systems.

39534 **(EUR—11281) Solar swimming pool at Louvain-la-Neuve: Demonstration project: Final report.** Opfergelt, D. (Commission of the European Communities, Luxembourg). 1988. 77p. (FR;EN). NTIS (US Sales Only), PC A05; 1; GPO Dep. Order Number DE88012629/JAW.

This report presents the functioning results of the swimming pool located on Louvain-la-Neuve, where solar panels were placed for heating the pool and sanitary water. This project has completed a demonstration project in the field of swimming pool solar heating as a part of the Commission of European Communities demonstration program on solar heated swimming pools comprising 52 pools distributed all over the community. The CEC contributed some 40% of the cost of solar equipment and monitoring. The "swimming pools" complex of Louvain-la-Neuve chiefly includes two covered swimming pools, the water-level of which has a total surface of 600m². 700m² solar collectors were placed on the roof of the low swimming pool in order to produce sanitary hot water and 150m² solar collectors were placed on the roof of the high swimming pool in order to heat the water of the pools. The performance measured from August 84 to July 86 shows a useful energy of 376 kwh/m² year for the pools heating system and of 196 kwh/m² year for the hot water heating system. Since its setting, this installation gives all satisfaction to all users of the swimming pool.

39535 **(IBI—ER803E) Residential solar retrofit in Canada.** (IBI Group, Toronto, Ontario (Canada); Hooper and Angus Associates Ltd., Toronto, Ontario (Canada); Department of Energy, Mines and Resources, Ottawa, Ontario (Canada). Renewable Energy Resources Branch). May 1979. 121p. (CE—01505). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

The objective of this study is to assess the state-of-the-art and degree of diffusion of active solar residential retrofitting in Canada, and to assess preliminary socio-economic costs and benefits of solar retrofit systems. An audit was undertaken to estimate the numbers of active solar space and water heating residential retrofits across the country, done by a telephone survey of householders, solar manufacturers, suppliers and installers, and groups involved in solar technology diffusion. A second audit was conducted to assess the state-of-the-art of residential solar retrofitting by using the information obtained during the first audit to select retrofits for detailed auditing. The data and impressions collected during the two audits, amplified by study of the relevant literature, were then used to identify and order the spectrum of significant factors involved in the retrofitting process. The critical factor identified is the assessment of the existing housing stock in the light of specific siting, orientation, formal, constructional and mechanical criteria. The remainder of the study addresses the cost benefits of solar retrofits, comparing the virtues of space heat and domestic hot water systems. Three of the audited systems are chosen for detailed economic discussion and critical factors of method of implementation, local energy costs, solar contribution and load factor are identified. Some alternatives to solar retrofit are presented and evaluated. Finally, an approach to assessing the retrofit potential of the existing housing stock is presented using cost-effective methods of aerial photography and use of existing data. 7 refs., 54 figs., 6 tabs.

39536 **(IC—87/373) Design, construction and experimental study of Electric Cum Solar Oven-II.** Nandwani, S.S. (International Centre for Theoretical Physics, Trieste (Italy)). Nov 1987. 26p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702993/JAW.

As in many developing countries, 35-40% of the population of Costa Rica still use firewood for domestic cooking. Considering the fact that Costa Rica is blessed with good sunshine, good hydroelectric potential, and a good electric network, a hybrid solar oven was thought to be useful. In the present paper the construction and working of a new type of Electric Cum Solar Oven (ECSO) has been described. This oven can be used for cooking and baking any type of meal at any time during the year employing solar and/or electric energy but consuming the minimum quantity of electric energy in case it is required. (author). 9 refs, 6 figs, 1 tab.

39537 **(LC—SURVEY3) Survey of United States domestic solar water heater designs and experiences.** (Little (A.D.) of Canada Ltd., Toronto, Ontario). Oct 1982. 43p. (CE—01669). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

A survey of information on US operational experience with various types of solar domestic water heating systems was carried out. Twenty-two field monitoring programs and three laboratory test programs were reviewed. The major findings were as follows. Installation problems, common in early programs, were not mostly resolved. The reliability of controllers, a major source of failure with early systems, appears to be improving. In most programs, energy savings are close to design expectations of 40-70%. The majority of systems installed to date in large US programs use forced circulation, liquid heat transfer fluids, and have antifreeze or drainback freeze protection. Drainback systems appear relatively free of operational problems. Glycol degradation in antifreeze systems could become a critical operational problem. Freeze up in draindown systems due to controller or drain valve malfunction is a critical oprational problem but reliability is improving. There is not enough operational experience with thermosyphon systems, phase change systems, air systems, or systems which use recirculation freeze protection, to define any key operational problems. 30 refs., 4 figs., 2 tabs.

39538 **(NRC/BR—104F) Solar heating of buildings in Canada.** Sasaki, J.R. (National Research Council of Canada, Ottawa, Ontario. Div. of Building Research). Mar 1976. 23p. (In French). (CE—01486). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

This report reviews current systems of solar heating in Canada and compares, on an economic basis, this type of heating

with conventional methods. It also gives certain guidelines relating to the choice of such systems. Basic components including collectors, heat storage systems, and piping, are described along with the factors that affect their performance, such as collector orientation, choice of fluids, and durability. While solar heating does not appear to be competitive with conventional means as yet, the cost difference is not excessively important and may decrease over time. Also, because of the possible large-scale fuel savings, it is worth supporting the development and implementation of solar heating systems adapted to the Canadian climate. 6 refs., 16 figs.

39539 **(NRC/E—5) 1983-1984 Solar Energy Program.** (National Research Council of Canada, Ottawa, Ontario. Div. of Energy). Jul 1983. 16p. (CE—01508). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

This paper outlines the objectives of the Solar Energy Program of Canada's National Research Council (NRC). Previous, current, and future research programs are outlined in the areas of solar heating, commercialization of solar heating systems, and photovoltaic technology and its commercialization. Cooperation with other NRC divisions, and with other countries through The International Energy Agency, is also discussed.

39540 **(NRC/E—COOLING1) Conceptual design of a residential sized solar air conditioning system.** Mandelstam, D. (National Research Council of Canada, Ottawa, Ontario. Div. of Energy). Nov 1982. 91p. (CE—01533). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

The objective of this work was to determine the cost effectiveness of a solar hot water absorption cooling package for overseas residential properties operated by the Canadian Department of External Affairs. The current technologies available for solar cooling and the choice of system configurations were evaluated. It was determined that, with currently available technology, the optimum system would use selective absorber flat-plate single-glazed collectors coupled to a hot water absorption chiller and coooling tower. Both hot-side and cold-side storage should be provided, and a conventional compression air conditioning unit used as back-up. Using a computer simulation program, it was determined that a 7 kW system using 30 m/sup2/ of collectors would provide approximately 45 GJ/y energy savings. The system cost was estimated to be about $24,000. This indicated that if a better than 10-year straight line payback is required, the system is cost effective in areas where energy prices are greater than $0.17/kWh and average solar insolation over the year is greater than 20 MJ/m/sup 2// d. 13 refs., 6 figs., 29 tabs.

39541 **(PB—88-181334/XAB) Compiled data from Kerava Solar Village, 1983-1986.** Peippo, K.; Peltola, S. (Helsinki Univ. of Technology, Espoo (Finland). Dept. of Technical Physics). 1 Feb 1988. 197p. (TKK-F-B—108). NTIS, PC E07/MF A01.

The Kerava Solar Village (KSV) has been in full operation since May 1983. The heating-system performance has been monitored continuously since then. The measurement results have been analyzed at Helsinki University of Technology, Nuclear Engineering laboratory, and the main results have been published in several reports. This report contains graphical presentations of most of the raw data and is intended for readers interested in details of the heating-plant operation. Because of the enormous amount of data, mainly statistical distributions are presented. Time series are given only for those measurements made on a daily basis. Also, descriptions of the heating system and operating modes are omitted since they can be found in other publications like DE87-751102 and PB84-112218.

39542 **(PB—88-190947/XAB) Low cost approach to passive solar heating: the CLEEHP (Cape Low Energy Experimental House Project) Project.** Ja, B. (Council for Scientific and Industrial Research, Pretoria (South Africa). National Building Research Inst.). 1983. 14p. (R/BOU—1091). NTIS, PC E04/MF E04.

The Cape Low Energy Experimental House Project (CLEEHP) consists of six small and relatively inexpensive houses (US $11,000) constructed in the winter-rainfall area of the country in order to study the potential of passive solar heating, increased thermal performance, the performance of different water-heating systems, and to develop and test design tools. Each house incorporates a specific passive-solar-heating measure, mostly of a type that can be added as a retrofit to existing houses. Detailed costs for these passive measures have yet to be obtained.

39543 **(WU—SIM1) The method of efficiencies: user manual active solar heating systems.** Carpenter, S.C. (Waterloo Univ., Ontario (Canada)). May 1982. 25p. (CE—01673). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

The method described in this manual for calculating the solar contribution to a solar domestic heating system would be useful to someone with a technical background. Calculations can be performed on a simple hand computer. The method does assume a well-designed system with a properly sized heat exchanger between the collector loop and storage. With this method one can calculate the collector area for a given demand if the collector characteristics and storage volume are known. Meteorological data appropriate for the method are given for 10 Canadian cities. Comparison of the results from the Method of Efficiencies with those of the more sophisticated simulation program WATSUN shows excellent agreement for typical conditions with an average error of 3%. 5 refs., 1 fig., 2 tabs.

39544 **(WU—SIM2) User manual for the method of efficiencies: active solar water heating systems.** Carpenter, S.C. (Waterloo Univ., Ontario (Canada)). Jun 1982. 17p. (CE—01674). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

The method descibed in this manual for calculating the solar contribution to a solar domestic hot water system would be useful to someone with a technical background. Calculations can be performed on a simple hand computer. The method does assume a well-designed system with a properly sized heat exchanger between the collector loop and storage. With this method one can calculate the collector area for a given demand if the collector characteristics and storage volume are known. Meteorological data appropriate for the method are given for 10 Canadian cities. Comparison of the results from the Method of Efficiencies with those of the more sophisticated simulation program WATSUN shows excellent agreement for typical conditions with an average error of 3%. 5 refs., 1 fig., 2 tabs.

39545 **Solar water heater system reliability improving.** Bingham, C. *Solar Today;* 1: No. 3, 18-19(May-Jun 1987).

Reliability has always been an important factor in active solar energy systems. Previous reports have identified problems with systems installed before 1983. The question is: whether these problems have been resolved, and state-of-the-art systems show an improvement in reliability. Several reports have recently become available that provide data on component reliability and maintainability. Their finding indicate that most components are more reliable than they were a few years ago, although freeze protection and control systems (sensors and controllers) still present problems in many systems. The reliability of solar water heater components is discussed.

39546 **Performance of roofpond cooled residences in U.S. climates.** Clark, G.; Loxsom, F.; Doderer, E.; Haves, P. (Trinity Univ., San Antonio, TX (US)). *Passive Solar Journal;* 4: No. 3, 265-292(1987).

The thermal advantages of a roofpond as an element of a residential cooling system are described. The authors conducted heat transfer experiments at two roofpond residences (RPRs) at Trinity University; the authors used data from these experiments to validate RPR simulations. Results of measurements of vertical and horizontal temperature differences within roofponds are discussed. Horizontal heat transfer within one water bag was effective. Ther-

mal resistance at the outer surface of a water bag with a deflated glazing can be significant. Simulation shows that an RPR can provide comfort without supplemental sensible cooling during almost all hours of a typical summer in any U.S climate. Ceiling fans are important in most climates. In the most demanding climates, the residence and the pond insulating panels must have high R-value. A map is included that provides RPR design guidance. The simulations indicate that dehumidification will be required to control mold, mildew, and ceiling condensation in an RPR in most climates; energy and power displacement by an RPR is sensitive to the humidity control required and the efficiency of the dehumidifier used.

39547 Transient development of stratification in a partially divided enclosure. Otis, D.R.; Jones, G.F. (King Fahad Univ. of Petroleum and Minerals, Dhahran (SA)). pp 307-312 of Natural circulation. Kim, J.H.; Hassan, Y.A. New York, NY; American Society of Mechanical Engineers (1987). (CONF-871234—).

From ASME winter meeting; Boston, MA, USA (13 Dec 1987).

In passive solar heating of buildings or in compartment fires, the authors are concerned with the development of thermal stratification when two rooms at different temperatures are connected by the opening of a door. They performed experiments and numerical calculations aimed at this application. The experiments consist of flow visualization and temperature measurements obtained when isolated halves of a tank containing water at two different temperatures are suddenly connected to allow flow between the zones. Two significant findings from this work are: 1) the presence of internal waves excited by the onset of flow through the doorway which have not normally been observed in past laboratory experiments, and 2) the equilibration time is found to be in general agreement with that predicted by a formula from a simple orifice model that they describe. Work is progressing on numerical simulations using two core stratification models connected by an orifice including entrainment in the neighborhood of the connection.

1410 Solar Collectors And Concentrators

REFER ALSO TO CITATION(S) 39543, 39554, 40127, 40372, 40373, 40374, 40375

39548 (BCH/RD—COLL16) Materials for solar collectors. (British Columbia Hydro, Vancouver (Canada). Research and Development). Jul 1983. 36p. (CE—01536). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

This report contains a listing of the required properties and the comparative advantages and disadvantages of materials that are commonly used in collectors. Current problems experienced with some materials are reviewed and observations on material durability are made based on field inspections of solar installations. Finally, the report contains suggestions for future work on the utilization of plastics, improvement of test methods, development of glazings and absorber coatings, and elimination of minor installation problems. The conclusions reached are that existing materials problems are minor but that better materials selection and development might reduce the cost and improve the aesthetics of collector installations. 53 refs.

39549 (SAND—87-1425C) Commercial direct absorption receiver design studies. Tyner, C.E.; Wu, S.F. (Sandia National Labs., Albuquerque, NM (USA); Foster Wheeler Solar Development Corp., Livingston, NJ (USA)). 1988. Contract AC04-76DP00789. 10p. (CONF-880655—2). NTIS, PC A02/MF A01;1; GPO Dep. Order Number DE88011685/JAW.

From 4. international symposium on research, development and applications of solar thermal technology; Santa Fe, NM, USA (13 Jun 1988).

We have examined receiver-specific aspects of a direct absorption receiver (DAR) for use in a commercial solar central receiver system, emphasizing differences between previous salt-in-tube (SIT) receiver designs and the DAR. Our final design to accommodate the structural and thermal stresses imposed by the severe solar environment is a thin, continuous, cylindrical shell, pretensioned vertically to eliminate potentially damaging compressive stresses and to help absorb wind loading. This shell is also compressively loaded from inside, through a rigid subpanel and a layer of dense fiber insulation, to provide vibration dampening and horizontal pretensioning of the shell. This DAR will be 40% lighter and 30% less expensive than a comparably sized SIT receiver. These advantages, coupled with the substantial annual performance benefits of the DAR, give it the potential to reduce levelized energy costs from solar central receiver systems by about 15%. 14 refs., 6 figs., 2 tabs.

39550 (SAND—87-8003) 10 MW/sub e/ Solar Thermal Central Receiver Pilot Plant heliostat and beam characterization system evaluation, November 1981-December 1986. Mavis, C.L. (Sandia National Labs., Livermore, CA (USA)). May 1988. Contract AC04-76DR00789. 202p. NTIS, PC A10;3. Order Number DE88011359/JAW.

Test and evaluation results for the heliostats and beam characterization system at the 10 MW/sub e/ Solar Thermal Central Receiver Pilot Plant are described in this report. Southern California Edison operated and maintained the plant during the five years covered by this evaluation. Therefore, the results represent what can be expected from a large number of heliostats that are operated over a long period of time in a power plant environment. The heliostats and beam characterization system were evaluated for their ability to meet performance and survival requirements. Heliostat evaluation results are reported for mirror soiling rates, mirror corrosion, wind loads, availability, maintenance requirements, tracking accuracy, beam quality, component temperatures, and operating power requirements. The heliostat beam characterization system accuracy is given for the measurement of beam quality, heliostat tracking accuracy, and power in the reflected beam. The heliostat technical specifications and design description are provided, and a detailed design description of the beam characterization system is included. 41 refs.

39551 (SE—1982) Cost effectiveness comparison of solar collector candidates for the solar utility. Executive summary. (Spectral Engineering Ltd., Toronto, Ontario (Canada)). 1982. 58p. (CE—01660). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

The objective of this work was to develop and apply a consistent comprehensive methodology for evaluating the cost effectiveness of the principal generic solar collector types, in configurations which would be capable of delivering 10,000 to a million GJ/y of heat energy. An analysis developed for 5 collector types, was applied to 5 sites representing the principal geographic and climatic regions of Canada. The work evaluated each collector candidate at its current state-of-the-art, using hour-by-hour analysis for 1967-76. Collector field layouts were designed, and such factors as costs, heat losses, pumping power, and service requirements were evaluated for each. It was found that heat losses from the field distribution piping become an increasingly significant liability as the field size increases, ultimately making some collector types unviable. The preferred collector choice is heavily dependent on the system field size. In terms of initial costs per unit area of collector aperture, the central receiver and point focus dish systems both ranked first; in terms of total costs per unit of useful heat energy delivered, the central receiver system ranked first. Based on a 30-year life-cycle cost analysis, the central receiver, in combination with an energy distribution system, will provide a community's heat requirements for 2-3 times the south central Canadian current blended energy prices. 33 figs., 5 tabs.

39552 (SV-UL—1987-38) Irradiation and flat plate collector performance in a northern climate. Brunstroem, C.; Karlsson, B.; Larsson, M. (Swedish State Power Board, Aelvkarleby). 30 Sep 1987. 7p. (CONF-870903—3). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88753759/JAW.

From International Solar Energy Society international congress on solar energy; Hamburg, F.R. Germany (13 Sep 1987).

Results from nine years of irradiation and solar collector performance measurements are reported. Empirically established relations between annual outputs and operating temperature for different types of flat plate collectors are presented. The nine years mean irradiation on 45/sup o/ tilted south directed surface was 1101 kWh/m/sup 2/. The useful collector plane irradiation restricted to irradiances above 300 W/m/sup 2/, to the months March to October and to the hours between 06.00 and 18.00 is close to 800 kWh/m/sup 2/. Annual outputs exceeding 350 kWh/m/sup 2/ were obtained with efficient flat plate collectors at operating temperatures up to 70/sup o/C. (authors).

1420 Heat Storage

30553 (EUR—10928-EN) Evaluation of thermal storage for solar heating systems. Final report. (Executive summary). Marshall, R. (Commission of the European Communities, Luxembourg. Directorate General Telecommunications, Information Industries and Innovation; University Coll., Cardiff (UK)). 1987. 49p. Commission of the European Communities, Luxembourg. Office for Official Publications of the European Communities.

Energy.

This is an Executive Summary of the Final Report to the sponsors. The study had a single objective: to develop a methodology which relates the design parameters which specify a combined solar heating system to long-term system performance. The methodology, known as the SEU Design Method, consists of four steps: derivation of the fundamental equation, formation of the key non-dimensional groupings after introducing suitable reference parameters, establishment of the Design Method correlation constants, and validation of the method. Extensions to the Design Method are derived to include the effects of pipe losses, pump powers, and a heat exchanger embedded in the store. The equations so derived show the link between the SEU Design Method and the key storage parameter, its overall fluid to storage material heat transfer capacity, UAsub(tf,s). To account for the effects of stratification, a heuristic correction factor is derived using a simple analytic theory. In the light of experience with the Cardiff storage device, it is concluded that the link between all the system parameters and system performance has been established. This conclusion needs to be tested for the other storage devices represented in the concerted action programme of the European Commission. The implication is that a method is now available for the examination of any solar system design incorporating storage for both thermal performance and economics with a minimum of computational effort. (orig./HW)

30554 (K/CSD/TM—77) Thermal radiative transport through LiF for temperatures near the melting point. Williams, P.T. (Oak Ridge National Lab., TN (USA)). Jun 1988. Contract AC05-84OT21400. 48p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88011586/JAW.

As a part of NASA's Advanced Solar Dynamics Program, lithium fluoride (LiF) is being studied as a phase-change material for energy storage in a solar receiver. This report investigates thermal radiation in LiF at temperatures near the melting point. Using a simple, one-dimensional model problem, scoping calculations are carried out to estimate the relative importance of radiation as a mode of heat transfer through a 1.35-cm layer of LiF. When compared with conduction in the solid phase and buoyancy-driven convection in the liquid phase, radiation plays a significant but not dominant role for temperatures near the melting point. The theory of radiant heat transfer through an absorbing/emitting medium with nonunity index of refraction is reviewed, and a two-band energy approximation is proposed as a modeling approach for LiF. This method is prompted by the nature of a single crystal spectral absorption coefficient distribution for LiF. For the wavelength band from 0–5.5 μm, it is recommended that LiF be treated as a fully transparent, nonparticipating medium. Above 5.5 μm LiF is assumed to be optically thick, and the diffusion method can then be applied in the solution of the energy equation for the material. 23 refs., 15 figs.

30555 (ORNL/TM—10665) Thermal analysis of heat storage canisters for a solar dynamic, space power system. Wichner, R.P.; Solomon, A.D.; Drake, J.B.; Williams, P.T. (Oak Ridge National Lab., TN (USA)). Apr 1988. Contract AC05-84OR21400. 54p. NTIS, PC A04/MF A01;1. Order Number TI88008960/JAW.

A thermal analysis was performed of a thermal energy storage canister of a type suggested for use in a solar receiver for an orbiting Brayton cycle power system. Energy storage for the eclipse portion of the cycle is provided by the latent heat of a eutectic mixture of LiF and CaF_2 contained in the canister. The chief motivation for the study is the prediction of vapor void effects on temperature profiles and the identification of possible differences between ground test data and projected behavior in microgravity. The first phase of this study is based on a two-dimensional, cylindrical coordinates model using an interim procedure for describing void behavior in 1{minus}g and microgravity. The thermal anaylsis includes the effects of solidification front behavior, conduction in liquid/solid salt and canister materials, void growth and shrinkage, radiant heat transfer across the void, and convection in the melt due to Marangoni-induced flow and, in 1{minus}g, flow due to density gradients. A number of significant differences between 1{minus}g and 0{minus}g behavior were found. These resulted from differences in void location relative to the maximum heat flux and a significantly smaller effective conductance in 0{minus}g due to the absence of gravity-induced convection.

30556 (SAND—87-3002) Performance evaluation of molten salt thermal storage systems. Kolb, G.J.; Nikolai, U. (Sandia National Labs., Albuquerque, NM (USA); Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt e.V., Koeln (Germany, F.R.)). Feb 1988. Contract AC04-76DP00789. 100p. NTIS, PC A06/MF A01;1; GPO Dep. Order Number DE88009786/JAW.

The thermal performance of the molten salt thermal storage system located at the Central Receiver Test Facility (CRTF) was measured. The 7-MWht system is composed of a hot storage tank containing molten nitrate salt at a temperature of 1050{degree}F (566{degree}C) and a cold tank containing 550{degree}F (288{degree}C) salt with associated valves and controls. The thermal performance of this system was evaluated and compared with the CESA-1 and Themis salt storage systems developed by the European solar community. Results of the comparison indicate that the performance of the three salt storage systems is similar. Test data were also used to validate a simulation model of the CRTF system and a proposed commercial-scale system (1200 MWht). The simulation model of the 1200-MWht system predicted an annual system efficiency of greater than 98%. The simulation also predicted that a relatively small amount of parasitic energy would be required to prevent the salt from freezing during a typical operating year.

30557 (SV-UL—1987-39) Lyckebo Project - Heat losses from a rock cavern storage. Brunstroem, C.; Eftring, B.; Claesson, J. (Swedish State Power Board, Aelvkarleby). 29 Sep 1987. 7p. (CONF-870903—4). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88753760/JAW.

From International Solar Energy Society international congress on solar energy; Hamburg, F.R. Germany (13 Sep 1987).

A hypothesis explaining the high heat losses from the Lyckebo rock cavern heat storage is presented. A convective heat flow through a crack system from the cavern top via a tunnel surrounding the cavern and back to the storage bottom through an expansion duct is suggested. It is shown that a water flow of around 2 m/sup 3//h is possible in the actual system. Computer simulations of cavern heat losses and cavern temperatures taking this type of convection into account give results in excellent agreement with measurements. The hypothesis is also supported by unexpectedly high water temperatures measured in the expansion tunnel system and by measurements of rock temperatures and deformations close to the top of the cavern. (authors).

15 GEOTHERMAL ENERGY

1501 Resource Status And Assessment

39558 (AD-A—191287/2/XAB) **Structural interpretation of the Coso geothermal field. Summary report, October 1986-August 1987.** Austin, C.F.; Moore, J.L. (Naval Weapons Center, China Lake, CA (USA)). Sep 1987. 40p. (NWC-TP—6841). NTIS, PC A03/MF A01.

The Coso Geothermal Field, located east of the Sierra Nevada at the northern edge of the high Mojave Desert in Southern California, is an excellent example of a structurally controlled geothermal resource.

1502 Geology And Hydrology Of Geothermal Systems

39559 (LBL—23940, pp 177-183) **Deformations and inferred stress field sensitivity for ellipsoidal sources at Long Valley, California, 1975-1982.** Wu, M.; Wang, H.F. (Univ. of Wisconsin, Madison (USA)). Sep 1987. NTIS, PC A10/MF A01. Order Number DE88004885/JAW. (CONF-8703199—).

From Symposium on the Long Valley caldera: pre-drilling data review; Berkeley, CA, USA (17 Mar 1987).

Ground deformation and seismicity observed from 1975 to the present support the existence of a major body of magma within the central part of the Long Valley caldera, California. Constraints on the source geometry are obtained from deformation modeling of uplift and trilateration data. The deformation data are analyzed with elasticity theory, which incorporates an ellipsoidal magma chamber, the Hilton Creek fault, and the South Moat fault. The solution for surface displacements due to an ellipsoidally-shaped cavity under a normal, uniform pressure is approximated by a combination of inversions and forward searches. The models for which the authors apply a generalized linear inversion satisfy the boundary conditions exactly on the free surface of the half-space but approximately on the ellipsoid. The forward models employ a normal pressure boundary condition over the surface of the magma body in addition to satisfying the free surface condition. Although geodetic data indicating significant surface deformation have been collected from 1975 to the present, the authors use the data of 1975-1982 as this period is the only one which contains both: (1) significant uplift data (in excess of 0.4 m) and (2) sufficient horizontal displacement data throughout the caldera. The importance of having both vertical and horizontal data in the inversion modeling of magma sources is that even extremely different models can fit the same set of vertical displacement data, as has pointed out by a number of authors.

39560 (LBL—23940, pp 1-7) **Relationship between basement geology, faults, and volcanic vents, Long Valley caldera, eastern California.** Bailey, R.A. (Geological Survey, Menlo Park, CA (USA)). Sep 1987. NTIS, PC A10/MF A01. Order Number DE88004885/JAW. (CONF-8703199—).

From Symposium on the Long Valley caldera: pre-drilling data review; Berkeley, CA, USA (17 Mar 1987).

Pre-Tertiary batholithic and roof-pendant structures have had a significant influence on the orientation of late Tertiary and early Quaternary faults in the Long Valley region, which trend north in the east and northwest in the west. Long Valley caldera lies within this zone of structural divergence, and its subjacent magma chamber formed in a region of unusual crustal disruption, expressed by local en echelon offset of the Sierran frontal faults. Precaldera volcanic vents show only weak and local alignment parallel to early-formed Sierran and Basin and Range faults. Postcaldera volcanic vents within the caldera show strong preferential northwest alignment along active Sierran frontal faults, which were apparently important magma conduits. The younger Mono-Inyo Craters volcanic chain trends more northerly, possibly reflecting a recent change in the local direction of extension from northeast-southwest to east-west.

39561 (LBL—23940, pp 8-11) **Overview of the Long Valley hydrothermal system.** Sorey, M.L. (Geological Survey, Menlo Park, CA (USA)). Sep 1987. NTIS, PC A10/MF A01. Order Number DE88004885/JAW. (CONF-8703199—).

From Symposium on the Long Valley caldera: pre-drilling data review; Berkeley, CA, USA (17 Mar 1987).

The hydrothermal system in Long Valley caldera is characterized by hot springs and fumaroles that discharge approximately 250 l/s of thermal water from vents located primarily around the south and east sides of the resurgent dome and in Hot Creek gorge. Although fluid discharge from some vents has increased since 1980 in response to increased levels of seismic activity, the total thermal water discharge has remained relatively constant. The most concentrated thermal fluids encountered to date contain 1000-1500 mg/l dissolved solids, with chloride concentrations of 250-280 mg/l. Nearly constant ratios of Cl/B (22) and Cl/Li (85) in hot springs and shallow aquifers throughout the caldera are indicative of a common reservoir source. The relatively low values of these ratios imply that the source reservoir may occur in marine sedimentary rocks of the Mt. Morrison roof pendant. Data recently acquired from hydrologic and geochemical monitoring and test drilling by government and industry groups confirms the existence of high-temperature reservoirs beneath the western moat within volcanic fill and underlying basement rocks. Additional information from geologic and geophysical investigations in the west moat have been used to infer that the principal zone of upflow of hot water occurs through basement rocks in the vicinity of the 100,000 year-old moat rhyolite. Estimates of the temperature of this upflowing fluid, based on recent geothermometer calculations, range from 220 to 230°C.

39562 (LBL—23940, pp 12-14) **Hydrologic and geochemical monitoring in Long Valley caldera, California.** Farrar, C.D.; Sorey, M.L.; Rojstaczer, S.A. (Geological Survey, Santa Rose, CA (USA)). Sep 1987. NTIS, PC A10/MF A01. Order Number DE88004885/JAW. (CONF-8703199—).

From Symposium on the Long Valley caldera: pre-drilling data review; Berkeley, CA, USA (17 Mar 1987).

A network of four wells, each instrumented with a submersible strain-bridge pressure transducer and barometric pressure sensor, provide continuous record of water-level and atmospheric pressure changes. These data and frequency analysis are used to produce a record of crustal strain. Continuous flow measurements of seven springs have been recorded over periods of 6 months to several years. Coseismic changes in flow volumes have been recorded indicating springs are sensitive to strain events. Chemical and isotopic data on the compositions of subsurface waters and gases show the detailed ground-water flow regime is more complex than the simple pattern of west to east ground-water flow as derived from hydraulic head data. Recent chemical and isotopic data from geothermal production wells at Casa Diablo and from exploration holes in the western moat provide the most reliable data on reservoir-fluid composition. Chemical geothermometers estimate reservoir temperatures of about 210-220°C. /sup 3/4/He ratios in gases from steam vents and springs increase from west to east across the caldera. The increase may be related to magmatic contributions of ^{3}He or may relate to water/rock interaction. Hilton and others (1986) note an increase in /sup 3/4/He in a spring vent in the central part of the caldera, from 1978-1983 with subsequent decrease following the 1983 seismicity. Several other investigative teams have conducted discrete time, regional, soil or soil-gas surveys (Hg, Rn, He) and also have collected continuous records of ^{222}Rn, H, and He at specific sites for periods of a few months to years. These results are briefly described.

39563 (LBL—23940, pp 43-53) **Upper crustal structure and seismicity in Long Valley caldera and vicinity.** Hill, D.P.; Kissling, E.; Kradolfer, U.; Cockerham, R.S. (Geological Survey, Menlo Park, CA (USA)). Sep 1987. NTIS, PC A10/MF A01. Order Number DE88004885/JAW. (CONF-8703199—).

From Symposium on the Long Valley caldera: pre-drilling data review; Berkeley, CA, USA (17 Mar 1987).

The authors have completed an interpretation of the seismic refraction profiles shot in 1982-1983 across Long Valley caldera

and the Inyo-Mono craters region and used the resulting velocity structure to develop a three-dimensional density model of the caldera consistent with the observed gravity field. Combined, these velocity-density models further improve the image of the distinctly three-dimensional structure of the caldera and the upper 5 to 6 km of the surrounding crust. Major episodes of earthquake activity in the Long Valley region have occurred at roughly 18 month intervals beginning with the M = 5.8 event beneath Wheeler Crest on October 4, 1978. With the exception of the September, 1981 M = 5.5 event in the Sierra Nevada block south of the caldera, each of these episodes has occurred in a different location defining a broad, irregular swath of seismicity south and east of the caldera. These earthquake sequences are dominated by strike-slip focal mechanisms along fault planes that, for the most part, show no correlation to the major range-bounding normal faults in the region. The 1986 Chalfant event is an exception in this regard; it appears to have involved slip on the west-dipping White Mountains frontal fault. Even in this case, however, the slip was dominantly strike-slip (right-lateral) with only a small normal component along a fault plane that is associated with one of the highest and steepest range fronts in the Basin and Range province.

39564 **Laboratory and simulation studies of solute transport in fracture networks.** Hull, L.C.; Miller, J.D.; Clemo, T.M. (Idaho National Engineering Lab., Idaho Falls (USA)). *Water Resources Research;* **23**: No. 8, 1505-1513(Aug 1987). Contract AC07-76ID01570.

Physical and numerical fracture network models have been used to analyze the transport of conservative solutes in systems of parallel-sided fractures. The processes controlling dispersion in fracture systems that are explicitly simulated by the numerical model are (1) development of a velocity profile within individual fractures, (2) transverse molecular diffusion between streamlines, both within fractures and at fracture junctions, and (3) advection with the bulk fluid through a system of fractures with a range of hydraulic gradients and apertures. The first two processes, referred to as microdispersion, are often assumed to be secondary to the third, referred to as macrodispersion. The validity of this assumption is, however, highly dependent on the hydrodynamics of the system under consideration. Data collected from a physical model of a fracture network are used to validate a numerical model that explicitly simulates all three transport processes. The numerical model is then used to evaluate the relevance of microdispersion processes in a system where macrodispersion is significant.

1503 Geothermal Exploration And Exploration Technology

REFER ALSO TO CITATION(S) 39559, 39561, 39562, 41123

39565 **(DOE/ID/12623—1) US geothermal database and Oregon cascade thermal studies: [Final report].** Blackwell, D.D.; Steele, J.L.; Carter, L. (Southern Methodist Univ., Dallas, TX (USA). Dept. of Geological Sciences). May 1988. Contract FG07-86ID12623. 94p. NTIS, PC A05/MF A01; 1; GPO Dep. Order Number DE88012464/JAW.

This report describes two tasks of different nature. The first of these tasks was the preparation of a data base for heat flow and associated ancillary information for the United States. This data base is being used as the basis for preparation of the United States portion of a geothermal map of North America. The "Geothermal Map of North America" will be published as part of the Decade of North American Geology (DNAG) series of the Geological Society of America. The second of these tasks was to make a geothermal evaluation of holes drilled in the Cascade Range as part of a Department of Energy (DOE)/Industry co-sponsored deep drilling project. This second task involved field work, making temperature logs in the holes, and laboratory work, measuring thermal conductivity measurements on an extensive set of samples from these holes. The culmination of this task was an interpretation of heat flow values in terms of the regional thermal conditions; implications for geothermal systems in the Cascade Range; evaluation of the effect of groundwater flow on the depths that need to be drilled for successful measurements in the Cascade Range; and investigation of the nature of the surface groundwater effects on the temperature-depth curves. 40 refs., 7 figs., 7 tabs.

39566 **(LBL—23940, pp 54-62) Structure of the crust and upper mantle in the Long Valley, California region as determined from teleseismic travel time residuals.** Dawson, P.B.; Iyer, H.M.; Evans, J.R. (Geological Survey, Menlo Park, CA (USA)). Sep 1987. NTIS, PC A10/MF A01. Order Number DE88004885/JAW. (CONF-8703199—).

From Symposium on the Long Valley caldera: pre-drilling data review; Berkeley, CA, USA (17 Mar 1987).

The analysis of teleseismic compressional waves has been developed in recent years to the point where it has been used to detect small anomalous velocity bodies in many volcanic areas. The experiment described here is designed to examine the deeper portion of the anomalous region seen by several investigators beneath the resurgent dome of Long Valley caldera. With the new data the authors are able to investigate the position of the postulated current magmatic system beneath the resurgent dome and to image the upper mantle and lower crust where, presumably, the source of mafic magmas supplying the magmatic system and the zone of interaction between the mafic magmas and crustal rhyolites occurs. The minimum size of resolvable structures is determined by the wavelength of the seismic waves and the spacing of sensors and is about 6 km.

39567 **(LBL—23940, pp 63) Three-dimensional P-wave velocity structure of the Long Valley region.** Kissling, E.; Ellsworth, W.L.; Cockerham, R.S. (Institut fuer Geophysik, Zurich (Switzerland)). Sep 1987. NTIS, PC A10/MF A01. Order Number DE88004885/JAW. (CONF-8703199—).

From Symposium on the Long Valley caldera: pre-drilling data review; Berkeley, CA, USA (17 Mar 1987).

Investigations of the crustal structure of Long Valley caldera and surrounding regions have been updated with an expanded set of travel time observations and revised computational procedures. The models presented are derived from 3831 well-distributed earthquakes observed by over 100 stations, producing 89,500 observations. The three-dimensional velocity structure is determined by iterative solution of the coupled hypocenter/structure problem using the parameter separation strategy of Pavlis and Booker (1980) as implemented by Thurber (1981). The authors solve for the velocity perturbations using both approximate methods (commonly referred to as tomography) and full matrix methods (as originally applied in the teleseismic imaging problem by Aki, Christofferson and Husebye (ACH) 1977). Several well-defined regions of laterally-varying structure were found outside of the caldera and deserve mention. The Sierran block south of the caldera is underlain by an intense low-velocity zone at depths greater than 14 km. The north-south extent of this body cannot be precisely defined, as it lies on the periphery of model. It may lie directly beneath the active earthquake source region south of the Caldera at a depth of 14-18 km or deeper and further to the south or both. Velocities are also significantly below average in Chalfant Valley at depths above the aftershocks of the M 6.4 earthquake. It was also found that on a regional scale the area north of the Caldera is slightly slower on average (1-3%) than the surrounding crust.

39568 **(LBL—23940, pp 64-72) Seismic reflection studies in Long Valley.** Berg, R.M.; Black, R.A.; Smithson, S.B. (Univ. of Wyoming, Laramie (USA)). Sep 1987. NTIS, PC A10/MF A01. Order Number DE88004885/JAW. (CONF-8703199—).

From Symposium on the Long Valley caldera: pre-drilling data review; Berkeley, CA, USA (17 Mar 1987).

Two normal-incidence and one wide-angle CDP reflection lines have been recorded in the Long Valley caldera. The first recorded in 1984 is an E-W line along the south side of Lookout Mountain and ending near the Unocal geothermal exploration drill hole on the west. The second line recorded in 1985 runs NW from Casa Diablo hot springs over a postulated domed magma chamber. The wide-angle profile was intended to duplicate the USGS refraction spread that recorded a reflection interpreted to come from a postulated magma chamber. Because of unusually unfavorable recording conditions, processing of this data required particular care.

39569 (LBL—23940, pp 73-83) **Mammoth Lakes wide angle seismic reflection experiment.** Malin, P.E.; Tono, H.L.; Murphy, W.J. (Univ. of California, Santa Barbara (USA)). Sep 1987. NTIS, PC A10/MF A01. Order Number DE88004885/JAW. (CONF-8703199—).

From Symposium on the Long Valley caldera: pre-drilling data review; Berkeley, CA, USA (17 Mar 1987).

In the summer of 1985 the authors recorded 2 seismic reflection profiles in the resurgent dome area of Long Valley Caldera. The data recording was done as a piggyback experiment in wide angle reflection profiling to the more standard vibroseis CMP profiles that were being shot by the University of Wyoming. While the UW vibrators profiled a 9 km, northwest-southeast line across the dome from roughly Casa Diablo to Lookout Mountain, their 48 channel recording equipment was alternated between linear, 1.5 km long ground arrays several km north and south of the vibrator line. These data have been edited, divided into groups of nearby shots, and diversity stacked to give 35 northern and 38 southern wide angle shot gathers. Static shifts in the first breaks of the gathers suggest that imaging deeper structures will depend critically on geometrically correct models and processing procedures for the shallow caldera fill and flows. A crude hand method of aligning first breaks from adjacent shots with overlapping traces was tested on the stacked data. The resulting travel time section shows several deeper arrivals, some of which can be interpreted in terms of known and inferred geological structures. The data in fact seem to image the Bishop Tuff at 0.5 and 2.0 km depth, and a much deeper horizon, below 10 km. To improve the static corrections and better understand the caldera geometry, the authors have traced rays through a range of models. The remaining work includes completion of the ray tracing, particularly using the models provided by the new gravity interpretation.

39570 (LBL—23940, pp 84-89) **Analysis of Long Valley spectral data using the NEWT system.** McNutt, S. (California Dept. of Conservation, Sacramento (USA)). Sep 1987. NTIS, PC A10/MF A01. Order Number DE88004885/JAW. (CONF-8703199—).

From Symposium on the Long Valley caldera: pre-drilling data review; Berkeley, CA, USA (17 Mar 1987).

A NEWT seismic system is operated by the California Division of Mines and Geology to monitor earthquakes in the Long Valley region. The system is primarily used to evaluate spectral properties of earthquakes that may be of volcanic origin, in order to improve the State's emergency response capabilities. From July 1984 to March 1987, 8500 events were recorded, and spectra have been obtained for about 30% of the total. Spectra are computed for all events between latitudes 37.4 and 37.8°N, and longitudes 118.5 and 119.1°W, including events both inside and outside Long Valley caldera. The purpose of this study is to present preliminary results of a systematic evaluation of NEWT S-wave spectra. The study consists of three parts: (1) comparison of spectra for earthquakes of different magnitudes but the same location; (2) comparison of spectra for earthquakes of similar magnitudes both inside and outside the caldera; and (3) comparison of spectra for a low-frequency event to spectra for normal earthquakes with similar magnitudes and locations.

39571 (LBL—23940, pp 90-96) **Analysis of borehole seismograms from Long Valley, California.** Elbring, G.J.; Rundle, J.B. (Sandia National Labs., Albuquerque, NM (USA)). Sep 1987. NTIS, PC A10/MF A01. Order Number DE88004885/JAW. (CONF-8703199—).

From Symposium on the Long Valley caldera: pre-drilling data review; Berkeley, CA, USA (17 Mar 1987).

In the fall of 1984, a three-component seismometer was emplaced in borehole OLV-1 at a depth of about 900 meters. Microearthquakes were recorded using this seismometer for a period of two months. Recording these events at a position beneath most of the caldera fill avoided much of the attenuation and multiples associated with such fill and provided much more interpretable records. Concentrating on the region of greatest seismic activity and structural interest, the authors confined their analysis to events with azimuths between 130° and 180° from the well location. The events analyzed were then further restricted to provide a wide range of hypocentral depths. Finally, the traces for both the vertical and two horizontal components were plotted as a function of depth versus time. Although these form unreversed vertical hypocentral profiles (VHP), interpretation of these sections should provide some information about the structure beneath the caldera. Based on these results, a final geologic interpretation is shown. The shallow structure is based on previous refraction work. The midcrustal low-velocity body is modeled as magma along with the region below the dipping reflector. The nature of the region below the reflector is only an assumption, however, since velocities are not defined for this area by this study. An altered zone is pictured surrounding this region to account for the secondary reflector seen in the S-wave data. Although this profile is not reversed and contains errors due to inaccuracies in the hypocentral locations, the model does agree well with previous studies of the area and provides a reasonable explanation of the observed travel times.

39572 (LBL—23940, pp 97-104) **Absence of evidence for a magma chamber in downhole and surface seismograms from Long Valley caldera, eastern California.** Hauksson, E. (Univ. of Southern California, Los Angeles (USA)). Sep 1987. NTIS, PC A10/MF A01. Order Number DE88004885/JAW. (CONF-8703199—).

From Symposium on the Long Valley caldera: pre-drilling data review; Berkeley, CA, USA (17 Mar 1987).

From September 22 to October 9, 1984 14 digital recorders were deployed, each with a three-component seismometer, to record local earthquakes in Long Valley, California. The instruments were deployed in two separate clusters: in the Casa Diablo region above a postulated magma chamber and just south of Lookout Mountain in a 900 m deep borehole OLV-1. To evaluate the applicability of the Elbring and Rundle (1986) method to data recorded by both downhole and surface stations, several tests have been made. First, an evaluation of the appropriate reduction velocity was carried out. Second, the observed and the calculated travel times for a flat layered model are compared. Third, the epicentral distances between the borehole station and the hypocenters from Elbring and Rundle (1986) and recalculated distances from HYPOINVERSE are compared. Fourth, to test for possible variations in the Vp/Vs ratio from 1.67 to 1.9 the ts/tp ratio (where tp and ts are the observed P and S travel times, respectively) for each event was plotted as a function of depth. The results of these tests are discussed.

39573 (LBL—23940, pp 105) **Preliminary analysis of 3-component seismograms for S-wave attenuation in Long Valley caldera.** Sanders, C.O.; Ellsworth, W.L. (Geological Survey, Menlo Park, CA (USA)). Sep 1987. NTIS, PC A10/MF A01. Order Number DE88004885/JAW. (CONF-8703199—).

From Symposium on the Long Valley caldera: pre-drilling data review; Berkeley, CA, USA (17 Mar 1987).

Preliminary analysis of 3-component seismograms from earthquakes recorded by portable seismic stations (16) deployed in the Long Valley caldera region, eastern California, from June to November 1984 reveals complexities in the S-wave attenuation structure in the caldera. Seismograms from two 8-km-deep earthquakes located near Casa Diablo and recorded at seismic stations to the NW and E-SE are relatively simple, with clear P- and S-wave arrivals. Seismic stations located at azimuths from N to E-NE record complex seismograms with multiple secondary arrivals and extended coda. Interpretation at present is difficult, but S-wave energy traveling through the caldera seems to suggest that attenuating structures can not be large and continuous. Simple seismograms recorded at these stations from a shallow earthquake beneath Mammoth Mountain and from a deep earthquake southeast of the caldera confirm the anomalous nature of deeper travel paths through the central Long Valley caldera. Detailed study of digital data, including polarization, spectral, travel-time, and first motion analysis of S, P, and other phases will help illuminate the finer structure of the caldera above about 8 km depth.

39574 (LBL—23940, pp 106-114) **Deep structure of Long Valley, California, based on deep reflections from earthquakes.** Zucca, J.J.; Kasameyer, P.W. (Lawrence Livermore National Lab., CA (USA)). Sep 1987. NTIS, PC A10/MF A01. Order Number DE88004885/JAW. (CONF-8703199—).

From Symposium on the Long Valley caldera: pre-drilling data review; Berkeley, CA, USA (17 Mar 1987).

Knowledge of the deep structure of Long Valley comes primarily from seismic studies. Most of these efforts have focused on delimiting the top of the inferred magma chamber. The authors present evidence for the location of the bottom of the low velocity layer (LVL). The data comes from a passive seismic refraction experiment conducted during August 1982. Fourteen portable seismograph stations were deployed in a network with approximately 5 km station spacing in the Mono Craters region north of Long Valley. The network recorded earthquakes located south of Long Valley and in the south moat. Three components of motion were recorded at all sites. The data represent one of the few times that three-component data has been collected for raypaths through a magma chamber in the Long Valley area.

39575 (LBL—23940, pp 115-116) **Pre-S observations at station SLK, NW of Long Valley, California.** Peppin, W.A.; Delaplain, T.W. (Univ. of Nevada, Reno (USA)). Sep 1987. NTIS, PC A10/MF A01. Order Number DE88004885/JAW. (CONF-8703199—).

From Symposium on the Long Valley caldera: pre-drilling data review; Berkeley, CA, USA (17 Mar 1987).

The authors have studied 280 observations of a pre-S phase seen at (and only at) the single uncalibrated vertical station SLK, NW of Long Valley, California. Of the earthquakes giving rise to this phase, most occur within an elongated zone south of the caldera. Observed travel times of P, S, and the SLK phase are shown in a figure. The lines give least-squares fit to the three sets of observations, and show that the pre-S phase is essentially parallel to S, but with a negative zero-distance intercept of 0.9029 +/- 0.052 second. The authors propose a model which fits not only the observations but also those of Zucca and others (1987). It consists of modeling the SLK phase as an S to P conversion on an interface striking N45E and dipping 45 degrees SW. The surface trace of this trend is indicated. While this trend is correlable with no surface geologic feature (being well NW of the boundary of Long Valley caldera), the intersection of raypaths from the sources to SLK through this plane are near the Inyo Craters.

39576 (LBL—23940, pp 117-121) **Potential field and electromagnetic studies.** Goldstein, N.E. Sep 1987. NTIS, PC A10/MF A01. Order Number DE88004885/JAW. (CONF-8703199—).

From Symposium on the Long Valley caldera: pre-drilling data review; Berkeley, CA, USA (17 Mar 1987).

In this segment of the Symposium, the speakers concentrate on three principal topics: gravity, electromagnetics, and deformation. Because of the limited time and the fact that the speakers who follow will delve into these topics with clarity and gusto, this paper is limited to an introductory overview of two geophysical topics that are not covered elsewhere in the Symposium, but deserve at least a brief mention. For the sake of completeness and because of their direct relationship to caldera processes, the author summarizes quickly key aspects of magnetics and self-potential.

39577 (LBL—23940, pp 122-135) **Three-dimensional gravity model of the geologic structure of Long Valley caldera.** Carle, S.F.; Goldstein, N.E. Sep 1987. NTIS, PC A10/MF A01. Order Number DE88004885/JAW. (CONF-8703199—).

From Symposium on the Long Valley caldera: pre-drilling data review; Berkeley, CA, USA (17 Mar 1987).

Long Valley caldera originated around 0.73 Ma upon the eruption of the Bishop Tuff, an extensive ash-flow tuff. Collapse of the roof over the magma chamber associated with the Bishop Tuff and subsequent volcanic resurgence have formed what is now an elliptical caldera measuring 29 km west-east by 15 km south-north, and having a maximum subsidence of 3.5 km. In addition to the Bishop Tuff, the caldera has been filled with the flows, dikes, and tuffs of resurgent volcanism, which has continued episodically up to recent time. Significant volumes of lake sediments, glacial till, alluvium, and reworked volcanics have been deposited in the caldera. The rocks of the caldera fill attain a maximum thickness of about 2.8 km, and because most of these rocks are less dense than the pre-caldera basement of granitics, metasediments, and metavolcanics, a gravity low of -50 mGal coincides with the caldera. The purpose of this study is to use all available gravity data and geological information to constrain a multi-unit, 3-D density model based on the geology of Long Valley caldera and its vicinity. Insights on the geologic structure of the caldera fill can help other geophysical interpretations in determining near-surface effects so that deeper structure may be resolved. With adequate control on the structure of the caldera fill, one is able to examine the gravity data for the presence of deeper density anomalies in the crust.

39578 (LBL—23940, pp 136-149) **Delineating the subsurface mega-structure of Long Valley caldera: regional gravity and magnetotelluric constraints.** Hermance, J.F.; Neumann, G.A.; Slocum, W. (Brown Univ., Providence, RI (USA)). Sep 1987. NTIS, PC A10/MF A01. Order Number DE88004885/JAW. (CONF-8703199—).

From Symposium on the Long Valley caldera: pre-drilling data review; Berkeley, CA, USA (17 Mar 1987).

One of the principal tectonic elements in the Long Valley volcanic complex is the presence of a deep basin-like caldera bounded by steeply dipping normal faults having characteristic offsets of at least several kms. This paper reports a magnetotelluric interpretation which delineates the subsurface structure of this feature. As a preliminary step the authors have reinterpreted regional gravity data in terms of a simple 3-D model employing the inverse algorithm of Cordell and Henderson (1968). Their gravity model clearly defines the major subsurface features of the caldera walls. In addition, the basin fill and major boundary faults impose a strong imprint on regional magnetotelluric (MT) data as well. A strong similarity is seen between gravity model and telluric thin sheet interpretations; this underscores the fact that both types of data are largely influenced by the same geologic features: the caldera fill, basement topography, and the major boundary faults. Moreover as in the earlier, preliminary MT interpretation of Hermance et al. (1984), the authors see a conductive zone beneath the southwest moat as well. In addition, however, they now have evidence for a resistive topographic high cutting across the main body of the caldera from the northwest to the southeast. The authors assume that this horst block is the same feature described as a central platform by Kane et al. (1976) from gravity studies and that it has been a major element in the structural evolution of the resurgent dome. Such a structural high is quite compatible with limited drilling data.

39579 (LBL—23940, pp 150-158) **Magnetotelluric profiling across Long Valley caldera.** Wannamaker, P. (Univ. of Utah, Salt Lake City (USA)). Sep 1987. NTIS, PC A10/MF A01. Order Number DE88004885/JAW. (CONF-8703199—).

From Symposium on the Long Valley caldera: pre-drilling data review; Berkeley, CA, USA (17 Mar 1987).

From November 17 to December 16, 1986, UURI collected thirteen tensor magnetotelluric soundings across the eastern half of Long Valley caldera. The period range of measurement was from less than 0.01 to 300 s and the data quality overall is very good to excellent. The purpose of the survey is to gain control of upper crustal conductivity structure and to ascertain the presence of a deep hydrothermal or magmatic system. The data the authors have collected is summarized in pseudosection form. The shallow conductive layer to the east and a very resistive basement especially in the west-central portion of the line are clear in both TE and TM modes. The very flat character of the TM phase phi/sub yx/ at long periods suggests uniform resistivity in the middle and lower crust, or at least inhomogeneities whose E-W extent is substantially less than their depths. Evidence for the NNW-trending deep conductor stated above lies in a high in phi/sub xy/ around 10 to 100 s beneath the resurgent dome, but extension of their profiling to the west is crucial to establish whether this represents an isolated axis.

39580 (LBL—23940, pp 159-166) **Three-dimensional interpretation of magnetotelluric data in Long Valley, California.** Park, S.K.; Torres-Verdin, C.; Morrison, H.F. (Univ. of California, Riverside (USA)). Sep 1987. NTIS, PC A10/MF A01. Order Number DE88004885/JAW. (CONF-8703199—).

From Symposium on the Long Valley caldera: pre-drilling data review; Berkeley, CA, USA (17 Mar 1987).

The volcanic complex at Long Valley is a silicic system which has exhibited recent activity, although the last major eruption was 700,000 years ago. Long Valley is of great interest because of three major reasons: (1) its potential for an eruption; (2) its potential for containing shallow magma; and (3) its potential for geothermal resources. Chevron Resources Company and Unocal both have detailed studies of Long Valley which have been proprietary until recently. In 1986, Chevron and Unocal released 77 stations of magnetotelluric data from Long Valley to the authors. Their goals were to develop interpretive methods in a complex volcanic environment and to confirm or deny the earlier assertion that the telluric data were insensitive to the presence of magma. The authors worked with many more MT sites (77 versus 23) and utilized a 3-D modeling program. All possible pertinent geophysical information was incorporated into the electrical model. The magnetotelluric response at frequencies from .001 Hz to 100 Hz is controlled almost completely by shallow structure in the caldera. The complex electrical structure in the first kilometer, coupled with a good conductor at a depth of 1500 m, effectively screens any deeper structure beneath the caldera. The authors present here an interpretation based principally upon phase. Static offsets of the sounding curves are so severe that the apparent resistivities were only useful in constraining the shallow structure. The phase was particularly sensitive to the presence or absence of the conductor at 1500 m.

39581 (LBL—23940, pp 167-174) **Geodetic monitoring of deformation within the Long Valley caldera, 1983.5-1987.1: data from the two-color geodimeter network.** Langbein, J. (Geological Survey, Menlo Park, CA (USA)). Sep 1987. NTIS, PC A10/MF A01. Order Number DE88004885/JAW. (CONF-8703199—).

From Symposium on the Long Valley caldera: pre-drilling data review; Berkeley, CA, USA (17 Mar 1987).

Since June 1983, the US Geological Survey has been frequently resurveying the lengths of several baselines within and near the Long Valley caldera. Measurements discussed here are made with a two-color geodimeter which has a precision characterized by $\sigma^2 = a^2 + b^2l^2$, where $a = 0.5$ mm, $b = 0.18$ ppm and l is the baseline length, which for this network is between 2.0 and 10.5 km. The initial network consisted of 13 baselines located within the south moat and straddling the zone of seismicity defined by the January 1983 earthquake swarm. The network has since been expanded to 40 baselines. Some of the new baselines are in the south moat area, some span the resurgent dome near Lookout Mountain, and others straddle the Hilton Creek fault as it enters the caldera. Measurements of 7 to 11 baselines are made frequently, ranging from once per month to several times per week. Other baselines are only measured infrequently, approximately once or twice per year. In this mode of operation, both good temporal and spatial distribution of measurements are achieved. Measurement procedures and data analysis for the two-color geodimeter network have been discussed elsewhere. The attached figures show the complete data through early March 1987 and a time series model that fits the data. The following discussion summarizes the data and their implications.

39582 (LBL—23940, pp 175-176) **Structural implications of strain and magnetic measurements in the Long Valley/Mono Craters region.** Johnston, M.J.S. (Geological Survey, Menlo Park, CA (USA)). Sep 1987. NTIS, PC A10/MF A01. Order Number DE88004885/JAW. (CONF-8703199—).

From Symposium on the Long Valley caldera: pre-drilling data review; Berkeley, CA, USA (17 Mar 1987).

Repeated magnetic measurements have been made since 1972 with a 32-site array in upper Owens Valley. The array extends through Long Valley, around Mono Lake, across the excelsior Mountains, and down Owens Valley. One or two sets of data have been obtained each year at each of the site pairs. Following the first Mammoth Lakes earthquakes in 1978, telemetered and portable recording magnetometers were also installed from Round Valley through the Long Valley Caldera. The primary feature in data from all sites between Round Valley and Mono Lake is a systematic and linear increase in field with time but with slightly different rates in different places. After correction for geomagnetic field secular variation, the rates peak to the north of Mono Craters at about 1 nT/a and fall off to the north and to the south through Long Valley. These data can be simply interpreted in terms of thermal remagnetization as a result of migration of the Curie point isotherm. A migration rate of about 1 m/a at a depth of 5 km will satisfy the data. At shallower depths the rate will be correspondingly less. A minor change in rate may have occurred in the south moat region starting in 1978. Simple tectonomagnetic models which incorporate either a pressure source at a depth of about 5 km or pressure triggered shear stress release on the Hilton Creek could explain this change. Borehole strain measurements recorded at the Devil's Postpile during the Chalfant earthquake do not indicate attenuated strain expected if a large solid/liquid plexes existed beneath Long Valley.

39583 (LBL—23940, pp 184-187) **Using surface displacement to constrain deformation at Long Valley caldera, CA.** Vasco, D.W.; Johnson, L.R.; Goldstein, N.E. Sep 1987. NTIS, PC A10/MF A01. Order Number DE88004885/JAW. (CONF-8703199—).

From Symposium on the Long Valley caldera: pre-drilling data review; Berkeley, CA, USA (17 Mar 1987).

During the ten-year interval 1975-1985 up to 47 cm of vertical displacement have been measured within Long Valley caldera. Four surveys from this period, those made in 1982, 1983, 1984 and 1985, are examined relative to a survey from 1975. Because leveling prior to 1975 detected little or no displacement, this survey may serve as a base for subsequent measurements. The magnitude of the uplift from 1975 to the present and the occurrence of strong earthquake activity within the caldera has led to the suggestion that magma intrusion has taken place. To derive constraints on the possible magma intrusion in the region the authors assume that the uplift is only due to volume expansion. The effects of local faulting and regional tectonic forces were accounted for through modeling and the addition of error terms. Using the uplift data, the authors examined (a) the bounds on the depth to the top of any intrusion satisfying the data, (b) the total volume change associated with the intrusion satisfying the data, and (c) the incremental volume changes associated with the intrusion for the years 1982, 1983, 1984, and 1985. It was found that magma intrusion occurred above a depth of 13 km. Two models of volume change between 1983 and 1985 were derived, each using different assumptions. The models have certain features in common, such as predominant expansion between 4 and 8 km and very little expansion below 12 km. These features agree with the results from other inversions of displacement data. They also support recent tomographic inversions in which the significant low P-velocity lies above 8 km.

39584 (LBL—23940, pp 15-17) **Mixing and boiling of thermal fluids in Long Valley caldera, California.** Shevenell, L.; Grigsby, C.O.; Goff, F.; Jannik, N.O.; Phillips, F. (Los Alamos National Lab., NM (USA)). Sep 1987. NTIS, PC A10/MF A01. Order Number DE88004885/JAW. (CONF-8703199—).

From Symposium on the Long Valley caldera: pre-drilling data review; Berkeley, CA, USA (17 Mar 1987).

Recharge to the Long Valley geothermal system occurs in the western part of the caldera along the Sierra Nevada front with the water being heated at depth and flowing laterally eastward into the caldera. As the Na-K-HCO_3-Cl fluids flow eastward they are increasingly mixed with meteoric water to form the more diluted fluids found within the caldera. Evidence for mixing is illustrated in plots of B and Li versus Cl and $\Delta^{18}O$ versus ΔD. Clear mixing trends exist between fluids similar in composition to thermal waters in the Casa Diablo area and cold, dilute ground waters, with the more concentrated fluids emerging in the western part of the caldera. Boiling is an important mechanism controlling the chemical compositions of thermal fluids in the Casa Diablo area. While boiling trends are coincident with mixing trends on the Li and B versus Cl plots, a plot of NH_4 versus Cl more clearly identifies the endmember, boiled, and mixed components of the thermal fluids. Assuming that the Casa Diablo well fluid is conductively cooled endmember geothermal water, the authors calculate steam fractions with Cl mass balance for Colton Hot Spring and Casa Diablo Hot Spring. Using these steam fractions and the gas distribution coefficient for NH_3 for single-stage boiling at 100°C, the authors can show that near surface boiling of Casa Diablo well fluids at 100°C can form waters with the compositions of Colton Hot Spring and

Casa Diablo Hot Spring. A 9% loss of steam during boiling of Casa Diablo well fluids produces a fluid with the composition of Colton Hot Spring, while a 19% steam loss would result in a fluid with the composition of Casa Diablo Hot Spring. One would expect an increase of ^{3}H and ^{36}Cl from west to east as fluids are progressively mixed because of a similar correlation in cold waters of the region between Bishop and Long Valley.

39585 (LBL—23940, pp 18-23) **Core hole into the hydrothermal system of the Long Valley caldera.** Wollenberg, H.; White, A.; Flexser, S.; Sorey, M.; Farrar, C. Sep 1987. NTIS, PC A10/MF A01. Order Number DE88004885/JAW. (CONF-8703199—).

From Symposium on the Long Valley caldera: pre-drilling data review; Berkeley, CA, USA (17 Mar 1987).

To investigate the present-day hydrothermal system, the Shady Rest hole was continuously cored 715m into the southwestern moat of the Long Valley caldera. The hole intersected 100 m of glacial till and 300 m of postcaldera rhyolite before entering the welded Bishop Tuff and bottoming in that unit. A sharp temperature rise over the upper 350 m, and near-isothermal conditions below reflect the presence of 200°C water moving through open, calcite-lined fractures in silicified Early Rhyolite and the Bishop Tuff. The depth to the Bishop is the shallowest encountered in holes in the caldera, and the temperatures measured are among the hottest observed in wells drilled within the caldera. Following repeated temperature surveys to determine an equilibrium profile, a portion of the casing in the high temperature zone was perforated, the fluids were sampled. Preliminary chemical analyses and calculated geothermometer temperatures are compared with analyses of a Casa Diablo geothermal well fluid. Planned investigations of Shady Rest core include alteration mineralogy, /sup 87/86/Sr and /sup 12/13/C measurements on fracture calcite, and /sup 18/16/O and H/D determinations on fracture minerals and whole-rock specimens. Uranium-series disequilibrium will be investigated in intervals indicated by gamma-ray logs. Major- and trace chemical constituents of fluid and gases will be analyzed, and measurements of fluid inclusion temperature will be attempted.

39586 (LBL—23940, pp 24-31) **Mapping the hydrothermal system beneath the western moat of the Long Valley caldera using magnetotelluric and time-domain electromagnetic measurements.** Nordquist, G. (Unocal Geothermal Div., Santa Rosa, CA (USA)). Sep 1987. NTIS, PC A10/MF A01. Order Number DE88004885/JAW. (CONF-8703199—).

From Symposium on the Long Valley caldera: pre-drilling data review; Berkeley, CA, USA (17 Mar 1987).

Geophysical surveys conducted by Unocal in the western Long Valley caldera have been designed to assess the hydrothermal system and to locate possible deep geothermal drilling targets. Interpretations based on magnetotelluric (MT) and time-domain electromagnetic (TDEM) measurements with constraints from structural mapping and well data have located a possible source area for the hydrothermal system. This region of potential upflow occurs at the intersection of major crustal structures in the western moat of the caldera. Data from these surveys are discussed.

39587 (LBL—23940, pp 32-38) **Constraints on models of structure and hydrothermal circulation in Long Valley caldera, California.** Suemnicht, G.A.; Varga, R.J. (Unocal Geothermal Div., Santa Rosa, CA (USA)). Sep 1987. NTIS, PC A10/MF A01. Order Number DE88004885/JAW. (CONF-8703199—).

From Symposium on the Long Valley caldera: pre-drilling data review; Berkeley, CA, USA (17 Mar 1987).

Long Valley caldera has been studied extensively by a number of agencies to evaluate models of caldera magmatism and the caldera's current eruptive potential. The data presented here are part of Unocal's exploration and assessment of the area's geothermal potential. The authors derive a model for the caldera based on surface mapping, structural and geophysical interpretation, and data from deep wells.

39588 (LBL—23940, pp 39-41) **Targets for future scientific drilling.** Sorey, M.L. (Geological Survey, Menlo Park, CA (USA)). Sep 1987. NTIS, PC A10/MF A01. Order Number DE88004885/JAW. (CONF-8703199—).

From Symposium on the Long Valley caldera: pre-drilling data review; Berkeley, CA, USA (17 Mar 1987).

The results from the two recent drill holes in the west moat provide useful stratigraphic and lithologic information and evidence of high temperature reservoirs in the Bishop Tuff and adjacent formations. However, the measured temperature profiles in these wells suggest that neither drill site is situated above the principal zone of thermal fluid upflow. Additional scientific drilling in this region is needed to adequately delineate the hydrothermal system and its heat source. Such drilling could also elucidate the magnitude of displacements on the various fault systems crossing the west moat. Three target areas are considered favorable for these purposes. These are described.

39589 **Reservoir sizing using inert and chemically reacting tracers.** Robinson, B.A.; Tester, J.W.; Brown, L.F. (Los Alamos Natl. Lab. (US)). *SPE (Society of Petroleum Engineers) Formation Evaluation;* 3: No. 1, 227-234(Mar 1988).

Nonreactive tracer tests in prototype hot, dry rock (HDR) geothermal reservoirs indicate multiple fracture flow paths that show increases in volume as a result of energy extraction. Tracer modal volumes can by correlated with estimated reservoir heat-transfer capacity. Chemically reactive tracers are proposed that will map the rate of advance of the cooled region of an HDR reservoir, providing advanced warning of thermal drawdown. Critical parameters are examined with a simplified reservoir model for screening purposes. Hydrolysis reactions are a promising class of reactions for reservoir temperatures ranging from 80 to 200°C[176 to 392°F].

1510 Direct Energy Utilization

39590 (DOE/ID/12490—1-Vol.1) **Hydrothermal energy extraction, Auburn, New York: Final report: Volume 1, Chapters 1-5.** Castor, T.P. (ENG, Inc., Cambridge, MA (USA)). Mar 1988. Contract FG07-83ID12490. 368p. NTIS, PC A16/MF A01;1; GPO Dep. Order Number DE88011288/JAW.

The installed hydrothermal energy extraction plant is designed to produce 1.954 MMBtu/hr at 145F on a continuous duty cycle and, under peak operating conditions, to deliver 6.03 MMBtu/hr of 140F water to the Main Building, Cayuga County Community College and the East Middle School, Auburn, New York. The plant is located on the contiguous campuses of the College and the School which straddle the Auburn low temperature geothermal reservoir. The Auburn reservoir, which is close to the Cayuga County anomaly (30C/km), is estimated to have proved geothermal reserves of 425 billion Btu and probable reserves and contiguous formations have possible natural gas reserves of 390 billion Btu. The maximum recoverable thermal energy over a six month heating season is 33 billion Btu. The Auburn reservoir could thus supply the total thermal requirements of both the College and the School for at least 42 heating seasons until the year 2030 if all the available hydrothermal energy could be utilized at its source temperature of 125F. The hydrothermal energy extraction pilot facility is currently designed to displace a total of 4.590 MMMBtu of energy at an estimated value of $36,025 in a representative heating season.

16 Environmental Aspects

REFER ALSO TO CITATION(S) 41374

1607 Tidal Power Plants

REFER ALSO TO CITATION(S) 41374

17 WIND ENERGY

1701 Availability (climatology)

39501 (AD-A—191621/2/XAB) Report on Project WIND - preliminary experiments with the UK Meteorological Office mesoscale model - September 1987. Interim report No. 2. (Reading Univ. (UK). Dept. of Meteorology). 28 Oct 1987. 12p. NTIS, PC A03/MF A01.

The Meteorological Office (MO) mesoscale model was run for simulation of the summer flow on 27 June 1985 in the Sacramento Valley, California. The purpose was to examine its predictive capability using the meso-Beta high-resolution observations obtained during Phase I of U.S. Army Project WIND and compare with it similar runs made with the ASL SIGMET model. The simulated region is a 460 X 460 km area centered at (39.75 N, 121.8 W) as in the SIGMET simulation by Williams et al., (1986). Three simulations were performed with the same topography, horizontal grid spacing (Delta-x Delta-y = 20 km) and period of integration, and also the same radiosonde initialization (that for Orchard, 1700 GMT) as in the SIGMET run. Topography of the region is illustrated including an artificial apron following the SIGMET run. Three simulations were performed and their characteristics are summarized. In the first simulation, the MO model was modified to run with vertical levels as in the SIGMET run (36, 116, 213, 330, 471, 4779, 6219 m) while the other experiments, Nos. 2 and 3, were run with the vertical spacings and number of levels (16) used by the operational MO mesoscale-model simulations. In the third run the evaporation resistance was increased from 100 to 500 s/m, resulting in effectively reducing the evaporation to nearly zero. This reflects the relatively dry conditions over the Sacramento Valley at that time.

1704 Economics

39502 (AD-A—191344/1/XAB) Space-time modeling with long-memory dependence: assessing Ireland's wind-power resource. Technical report. Haslett, J.; Raftery, A.E. (Washington Univ., Seattle (USA). Dept. of Statistics). Oct 1987. 30p. (TR—110). NTIS, PC A03/MF A01.

The Irish government has, in recent years, been considering the possibility of using wind energy to meet a significant portion of Ireland's energy needs. This paper describes a project aimed at developing methods for the evaluation of Ireland's wind-power resource. The authors consider estimation of the long-term average power output from a wind-turbine generator at a site for which little data on wind speeds is available. Long-term records of wind speeds at the twelve synoptic meteorological stations are also used. Inference is based on a simple and parsimonious approximating model that accounts for the main features of wind speeds in Ireland, namely seasonal effects, spatial correlation, short-memory temporal autocorrelation, and long-memory temporal dependence. It syntheses deseasonalisation, kriging, ARMA modelling, and fractional differencing in a natural way. A simple kriging estimator performs well as a point estimator, and good interval estimators result from the model. The resulting procedure is easy to apply in practice.

1705 Environmental Aspects

39503 (PB—88-203054/XAB) Electromagnetic interference to radar- and radiolink-systems caused by large-scale wind turbines. Ousbaeck, J.O. (Foersvarets Forskningsanstalt, Linkoeping (Sweden). Huvudavdelning 3). Feb 1988. 150p. (In Swedish). (FOA-C—30486-3.2). NTIS, PC E06/MF A01.

This report describes a method to calculate the electromagnetic interference to radar- and radiolink-systems caused by large-scale wind turbines. Some important factors that affect the carrier-to-interference (C/I) ratio are discussed, and a number of diagrams showing acceptable distance, for a given C/I ratio, are presented.

1706 Wind Energy Engineering

39504 (DOE/NASA/20320—74) Testing of a one-bladed 30-meter-diameter rotor on the DOE/NASA Mod-O wind turbine: Final report. Ensworth, C.B.F. III; Corrigan, R.D.; Berkowitz, B.M. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center; Sverdrup Technology, Inc., Cleveland, OH (USA)). Mar 1988. Contract AI01-76ET20320. 14p. (NASA-TM—100274). NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88008144/JAW.

Tests were conducted on the DOE/NASA Mod-O 200-kW horizontal-axis wind turbine in a one-bladed rotor configuration. The objectives of the test were to evaluate the performance, loads, and dynamic characteristics of a one-bladed rotor, and then to compare these parameters with those of an aerodynamically similar two-bladed rotor configuration. Test operations showed that this intermediate-size (15.2-m radius) one-bladed rotor configuration can be operated successfully. The test results indicate that the one-bladed rotor had cyclic blade loads that were comparable to the loads of a two-bladed rotor. A moderate power penalty equivalent to a reduction in windspeed of 1 m/sec occurred with the one-bladed rotor when operated at a rotor speed 50 percent higher than that of the two-bladed rotor. 2 refs., 8 figs., 1 tab

39505 (EUR—10791-EN) Collecting of new data on existing wind energy converters. Final report. January 1982-September 1983. Jensen, S.A.; Bjerregaard, E.T.D.; Paulsen, U.S. (Commission of the European Communities, Luxembourg. Directorate General Telecommunications, Information Industries and Innovation). 1986. 85p. Commission of the European Communities, Luxembourg. Office for Official Publications of the European Communities.

Energy.

A data recording system has been designed for measurements of meteorological data and data concerning the performance of a wind turbine. Measurements were carried out on two commercially available Danish wind turbines. One of the turbines was a 55 kW VESTAS wind turbine erected at a farm, and the other wind turbine was a 30 kW SONEBJERG wind turbine erected at a dwelling house. The test periods of the two wind turbines were approximately three months and two months respectively. The same measuring programme was carried out on both wind turbines. The programme included the following three types of measurements: Long-term measurements for the determination of wind statistics, power performance, and operation time; Short-term measurements for the determination of power quality, skew wind and brake functions, and finally supervision measurements in order to record the behaviour of the wind turbine during possible emergency situation. The 55 kW wind turbine has been tested at wind speeds up to 25 m/s, whereas the 30 kW wind turbine has only encountered up to 13 m/s during the test period. The performance of both wind turbines was well documented and the energy production from the wind turbines has been compared to the energy consumption by the owners. (orig.)

39596 (PNL—6543) Verification of the optimizing NOABL model using a spatially dense wind data set. Barnard, J.C.; Germain, A. (Pacific Northwest Lab., Richland, WA (USA)). Apr 1988. Contract AC06-76RL01830. 71p. NTIS, PC A04/MF A01;1; GPO Dep. Order Number DE88010332/JAW.

This report examines the ability of a numerical model--the optimizing NOABL model--to predict wind speeds and gross turbine power outputs over an area of complex terrain. To achieve this end, wind observations from a data set of high spatial density are compared to model predictions of the wind. Additionally, gross turbine powers, derived from the wind observations, are compared to the same quantity calculated from model-derived wind speeds. The model is operated using two approaches. With the first approach, The model is operated repeatedly in an attempt to construct wind speed frequency distributions over the modeled area; from these distributions mean speeds and gross powers are determined. With the second approach, the model is run only once using mean speeds as input. When the first approach is used, it is found that the wind speed and turbine power prediction errors are about 5% and 11%, respectively. When the second approach is employed, the wind speed and power prediction errors are about 5% and 13%, respectively. (Because the gross turbine power does not include many factors that influence turbine performance, the error in model predictions of actual turbine power is likely to be substantially higher, although this is no fault of the model.) Two other aspects of model application are also briefly investigated. First, it is found that the modeling results are sensitive to the location of the tuning sites; second, values of the model's stability parameter, {tau}, and the calculated wind direction, θ, derived for one modeling domain, are not transferrable to a nearby domain. 5 refs., 17 figs., 10 tabs.

39597 Operational characteristics of a large wind-farm utility-system with a controllable AC/DC/AC/interface. Thomas, R.J.; Phadke, A.G.; Pottle, C. (Cornell Univ., Ithaca, NY (US)). *IEEE Transactions on Power Systems;* 3: No. 1, 220-225(Feb.1988).

The assimilation of large numbers of large wind turbine generators into utility grids posses significant operational questions. This paper explores design and operational issues associated with the interconnection of wind farms using a controllable AC/DC/AC series-connected interface. The study is in terms of steady-state operation of and transient effects on both the power network and the wind system.

20 ELECTRIC POWER ENGINEERING

39598 (EPRI-EL—5804) Database management for power system planning: Final report. Carlsen, K.; Fink, L.H. (Electric Power Research Inst., Palo Alto, CA (USA); Carlsen and Fink Associates, Inc., Fairfax, VA (USA)). May 1988. 156p. Research Reports Center, Box 50490, Palo Alto, CA 94303;3. Order Number TI88009905/JAW.

This project was undertaken to assess the suitability of representative commercial data base management system (DBMS) for serving as a basis for integrating power system planning analysis software. A data base design was developed for that purpose, and implementation was attempted using the chosen commercial DBMS. Implementation was carried only far enough to demonstrate limitations due to the current state of the art in DBMS practice, which are related in large part to a commercial rather than engineering orientation. The data base design for power system analysis software integration that was developed is described in full. It appears suitable for implementation, given suitable means, and alternative means are discussed. Such means include existing special purpose software for the integration of engineering software, and possibly special purpose data base machines. 7 figs., 13 tabs.

2001 Power Plants And Power Generation

REFER ALSO TO CITATION(S) 39050, 39076, 39091, 39633, 39741, 39742, 40217, 40219, 40360, 41298

39599 (CONF-880373—2) On-line in situ particle measurements in a large scale coal-fired furnace. Holve, D.J.; Meyer, P.L.; Muzio, L.J.; Shiomoto, G.H. (INSITEC, San Ramon, CA (USA); Fossil Energy Research Corp., Laguna Hills, CA (USA)). 1988. Contract AC03-85ER80230. 21p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88011682/JAW.

From Western States Section/The Combustion Institute spring meeting; Salt Lake City, UT, USA (21 Mar 1988).

A compact, optical probe (PCSV-P) was developed to provide on-line, in situ particle measurements in large scale combustors. Southern Company Services arranged for a test series of the probe at the Watson Power Plant in Gulfport, Mississippi. The PCSV-P obtained measurements of particle concentration, size, and velocity in the furnace (1330{degree}C) and at the inlet and outlet of the electrostatic precipitator. Velocity measurements in the furnace gave values which were twice the volumetric mean velocity, indicating significant spatial variations in the furnace were consistent with optical probe and cascade impactor measurements at the entrance to the electrostatic precipitator (ESP). A comparison of optical probe velocities with measurements made by pitot tubes showed consistent trends in velocity values as a function of position at the entrance of the ESP duct. Cascade impactor and optical probe results were in good agreement for particle sizes up to 4-10 microns. The optical probe measures higher particle concentrations or sizes for particles larger than 10 microns. Differences in the large particle results are believed to be due primarily to unknown variations in particle density, morphology, and opacity. 10 refs., 12 figs., 2 tabs.

39600 (EPRI-AP—5823) Design of high-reliability gas turbine controls and accessories: Final report. Gallagher, W.F.; Multhaup, H.A.; Stephens, P.G.; MacFarland, W.J.; Della Villa, S. (Electric Power Research Inst., Palo Alto, CA (USA); General Electric Co., Schenectady, NY (USA)). Jun 1988. 359p. Unlimited audience, publicly available. Research Reports Center, Box 50490, Palo Alto, CA 94303;3. Order Number TI88012517/JAW.

Schematic diagrams and reliability analyses are presented for the "controls and accessories" systems for General Electric's Model 7F advanced gas turbine. This project was to apply rigorous reliability engineering methods to the design of a new gas turbine. The focus of the project was the controls and accessories systems, because in the past most of the failures occurred with these systems. A database of the reliability of each of the many components that make up the gas turbine was established from the maintenance histories of existing (similar) models. The project was successful in that it significantly influenced the design of a new electric power generating system. The report provides an in-depth analysis of each of the eighteen systems that make up the "controls and accessories" systems. 4 refs., 76 figs., 61 tabs.

39601 (EPRI-CS—5564) Remaining life assessment of superheater and reheater tubes: Final report. Paterson, S.R.; Rettig, T.W. (Electric Power Research Inst., Palo Alto, CA (USA)). May 1988. 295p. Research Reports Center, Box 50490, Palo Alto, CA 94303;1. Order Number TI88011532/JAW.

The purpose of this project was to provide a validated procedure in the form of a computer code and users guide for predicting the remaining useful life of Type SA213-T22 superheater and reheater tubes. The procedure was to be based on steamside oxide scale measurements, tube geometry measurements, and other readily available operating parameters. To achieve this objective, six tasks were performed. These were: (1) acquisition and compilation of oxide growth information for 2{1/4}Cr--1Mo steel, (2) acquisition and examination of Type SA213-T22 superheater and reheater tubes taken out of service after considerable service exposure or after the tube ruptured, (3) empirical development of a creep damage accumulation procedure which is accurate for nonsteady

state temperature and stress histories, (4) measurement of the steamside scale thickening and fireside wastage rates in tubes removed from service, (5) integration of the foregoing tasks into damage counting algorithms and casting these into a user-friendly computer code, and (6) comparison of the remaining life predictions made using the developed computer code with well characterized tube failures and with postexposure stress rupture test results obtained from a nonruptured service degraded tube. A user-oriented computer code for predicting the remaining life of superheater and reheater tubes using easily measured tube characteristics and readily available operational data were developed. This report provides the technical basis and background for this computer code. 60 figs., 11

39602 **(EPRI-CS—5856) High-reliability feedwater heater study: Final report.** Bell, R.J.; Conley, E.F. (Electric Power Research Inst., Palo Alto, CA (USA); Heat Exchanger Systems, Inc., Boston, MA (USA)). Jun 1988. 303p. Unlimited audience, publicly available. Research Reports Center, Box 50490, Palo Alto, CA 94303;1. Order Number TI88011928/JAW.

Closed feedwater heaters are used in both fossil and nuclear power plants to improve thermal performance. Escalating fuel costs are resulting in the justification for greater numbers of feedwater heaters in power plants and for larger feedwater heaters. The increasing fuel costs also make availability of feedwater heaters more critical. The lower heat rates made important by today's high fuel costs justify the need for highly reliable feedwater heating systems. Feedwater heater reliability is influenced by feedwater heater design, associated piping and control systems design, and the manner in which feedwater heaters are operated and maintained. Most feedwater heater problems appear in the form of tube failures. Many forms of tube failures are a result of improper material selection for the service. However, many failures are a result of inadequate protection against impingement at steam inlets and inadequate capacitance to avoid steam blow through the drain cooler. Other tube failures are a result of associated systems design. Insufficient venting will accelerate corrosion and can cause performance losses. Poor lay-up procedures can also accelerate corrosion and lack of maintenance of level controls can result in loss of liquid seal at the drain cooler inlet causing damage to tubes. The purpose of this report is to provide an assessment of which design features and operations and maintenance practices have the greatest effect on feedwater heater reliability. In addition, existing and new design concepts have been identified which will improve feedwater heater reliability. Further research needs for improving feedwater heater reliability have also been identified. 15 refs., 82 figs., 8 tabs.

39603 **(EPRI-EL—5889-Vol.3) Evaluation of software development tools: Volume 3, Tutorial: Final report.** Beardmore, J.A. (Electric Power Research Inst., Palo Alto, CA (USA); ORI, Inc., Rockville, MD (USA)). Jun 1988. 65p. Unlimited audience, publicly available. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88012776/JAW.

This report presents the results of an evaluation of software development and maintenance tools for power system planning and operations software. The objectives of the project were to determine the usefulness of currently available software development tools, to determine the requirements for software tools that are not currently available, and to make recommendations on the appropriate role for EPRI in tool usage and future tool development. The study accomplishments included defining a set of requirements for software development tools, conducting a tool survey that identified tools potentially satisfying the requirements, developing an evaluation methodology that can be adapted by a utility for performing its own tool evaluation, conducting a limited number of tool evaluations, and identifying potential EPRI roles and other desirable activities. The study found a large number of useful tools, many at low cost, but identified as a major unmet need its general goal of finding a reasonably small collection of tools that can comprehensively cover the priority requirements with maximum ease of use and minimum constraints placed on the using organization. This volume is a tutorial on software tools and their relationships to software development methodologies and the software life cycle. 95 refs., 2 tabs.

39604 **(EPRI-EM—5841) Cool storage marketing guidebook: Final report.** McDonald, C.; Davis, T. (Electric Power Research Inst., Palo Alto, CA (USA); Synergic Resources Corp., Bala-Cynwyd, PA (USA)). Jun 1988. 258p. Unlimited audience, publicly available. Research Reports Center, Box 50490, Palo Alto, CA 94303;3. Order Number TI88011777/JAW.

Use of cool storage for cooling in commercial buildings provides significant benefits to both the utility and the customer. For the customer, cool storage provides lower electricity cost and may provide secondary benefits including increased flexibility for meeting changing air conditioning loads, increased air conditioning capacity and increased space. For the utility, cool storage reduces peak sales, increases off-peak sales and may improve the competitive position of the utility. Over the past 5 years, over 30 electric utilities have developed active cool storage programs. Some of these programs have been extremely successful. Marketing to commercial sector can be extremely challenging due to the diversity of business and the complexity of decision making. This report provides guidance for developing and improving cool storage marketing programs. Descriptions of the marketing programs and lessons of experience from four electric utilities are documented. Commercial sector decision making is described. The barriers to cool storage and the best strategies to overcoming these barriers are reviewed. Detailed guidance for developing, implementing and evaluating a marketing plan is also provided. 12 refs. 26 figs., 24 tabs.

39605 **(EPRI-EM—5853) Developing energy-integrated industrial parks: Final report.** Oliker, I.; Major, W. (Electric Power Research Inst., Palo Alto, CA (USA); Burns and Roe, Inc., Oradell, NJ (USA)). Jun 1988. 44p. Unlimited audience, publicly available. Research Reports Center, Box 50490, Palo Alto, CA 94303;1. Order Number TI88011774/JAW.

This report assesses various aspects of developing cogeneration alternatives for existing electric generating stations. This study examines the relationships which enable cost comparisons of thermal production at the power plant and subsequent distribution with a cost of a thermal product that can be marketed at a competitive price to end users. The topics investigated include the modifications required to retrofit existing turbine installations to a cogeneration alternative, the amounts which can be practically extracted for this production, the thermal load, the distance from the power station which can be economically sustained, and cost associated with a cogeneration alternative. A strategy for marketing of the thermal product to nearby industrial parks is developed and an approach to elicit customer commitment is proposed. Cost components which contribute to the unit cost of thermal production are presented graphically to enable computations for purposes of comparing a cogenerated thermal product with on-site production. 3 refs., 12 figs., 6 tabs.

39606 **(EPRI-NP—5728) Verification of the ATHOS3 code against feedring and preheat steam generator test data: Final report.** Hopkins, G.W. (Westinghouse Electric Corp., Monroeville, PA (USA). Service Technology Div.; Electric Power Research Inst., Palo Alto, CA (USA)). May 1988. 560p. Research Reports Center, Box 50490, Palo Alto, CA 94303;1. Order Number TI88010317/JAW.

As part of the EPRI/Westinghouse Project RP1066-10, Westinghouse was contracted to verify the ATHOS3 computer code against both steady-state and transient thermal/hydraulic performance data obtained from operating Westinghouse Model F and D4 steam generators. This document presents descriptions of both steam generators, the test programs and data, the ATHOS3 simulation models of these units, the comparisons of the ATHOS3 predictions with the test measurements, and recommendations for improving the ATHOS3 code. The data comparisons indicated that the ATHOS3 code is capable of predicting the overall thermal/hydraulic performance of both Westinghouse feedring and preheat generators, and continues to be an important steam generator analysis tool. However, modifications to the default heat transfer model are recommended to improve the prediction of primary and secondary fluid temperatures. 8 refs., 219 figs., 15 tabs.

39607 **(FhG-IzfP—850303-TW) Quality assurance for ceramics and components of the gas turbine. Reporting period June 1, 1982 to May 31, 1984. Final report.** Reiter, H. (Fraunhofer-Gesellschaft zur Foerderung der Angewandten Forschung e.V., Saarbruecken (Germany, F.R.). Inst. fuer Zerstoerungsfreie Pruefverfahren). 4 Mar 1985. 49p. (In German). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88754149/JAW.

This report covers the results obtained by the joint project of IzfP, Saarbruecken and IZSM, Karlsruhe, who carried out non-destructive testing of silicon carbide and silicon nitride ceramics for determination of quality assurance criteria with regard to loading capacity and acceptance reference data. The specimens tested were made of RBSN, SSN, and SSiC. The four-point bending test specimens had artificially made flaws (pores, Fe, WC, and Si inclusions) between 50 μm and 500 μm in size. The nondestructive methods applied for testing and characterisation of the bending test specimens were ultrasonic testing and microfocus radiography. The ultrasonic tests for structural examination showed differences also between the series of a specific materials type. Sample series with higher sound velocity revealed a tendency towards better bending strength. The fracture mechanical results confirmed the dangerous effects of defects near the surface (under bending stress) and hence confirmed the necessity of enhanced nondestructive testing of the surface. (orig./HP) With 8 refs., 3 tabs., 20 figs.

39608 **(OH/RD—87/266/K) Standstill frequency response test Atikokan TGS [Thermal Generating Station].** Service, J.R.R. (Ontario Hydro Research Div., Toronto (Canada)). 23 Nov 1987. 45p. (MICROLOG—88-01746). Ontario Hydro Research Division, Editorial Section, 800 Kipling Ave., Toronto, Ont., Canada M8Z 5S4; $10.00 CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

A standstill frequency response (SSFR) test was conducted on the generator manufactured by Brown-Boveri Company at Atikokan Thermal Generating Station (Ontario). Testing was done in accordance with IEEE standard 115A-1987. Using a least-squares iterative technique, direct and quadrature axis equivalent circuits were fitted to the SSFR data. An unusual aspect of the Atikokan rotor is the presence of a squirrel-cage damper winding. The effects of this winding are illustrated by the absence of the first amortisseur circuit inductance, and the presence of a differential leakage element in the best-fit direct axis equivalent circuit. Fitting errors of the various equivalent circuit models with respect to the SSFR data are discussed. An appendix tabulates and shows plots of the SSFR test data. 9 refs., 25 figs., 9 tabs.

39609 **(OH/RD—87/267/K) Quantitative metallographic assessment of high temperature components.** Westwood, H.J.; Smith, F.W. (Ontario Hydro Research Div., Toronto (Canada)). 30 Nov 1987. 35p. (MICROLOG—88-01747). Ontario Hydro Research Division, Editorial Section, 800 Kipling Ave., Toronto, Ont., Canada M8Z 5S4; $10.00 CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

Surface replication is an important tool used in life assessment of thermal power plant units. The immediate application is damage/defect detection but it can also be used to characterize and quantify more subtle changes in the microstructure of low-alloy steels, changes which weaken the material and lead ultimately to failure. Quantitative metallographic techniques based on replication have been used to estimate metal temperatures in selected locations of several units in Ontario. The report analyzes the methods and results in some detail and identifies areas where work is needed. Also considered is the potential of estimating creep strain from microstructural studies. To obtain both temperature and strain in this non-destructive way would be very valuable in terms of life assessment. Because of the potential benefits, it is recommended that a specific research program on quantitative metallographic methods should be formulated and appropriately resourced. 14 refs., 7 figs., 4 tabs.,

39610 **(OH/RD—87/308/K) Risk assessment of many-component systems with specified spare provisioning policies.** Sim, S.H. (Ontario Hydro Research Div., Toronto (Canada)). 8 Dec 1987. 20p. (MICROLOG—88-02035). Ontario Hydro Research Division, Editorial Section, 800 Kipling Ave., Toronto, Ont., Canada M8Z 5S4; $10.00 CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

Markov models are proposed for risk assessment of many-component systems with specified spare provisioning policies. Unlike in existing models, each component is either repaired or discarded on failure. The probability of component shortage (risk probability) is calculated. The results will be useful for application in system, valves and small pumps in piping systems of generating stations. 6 refs., 7 figs.

39611 **(STF—15A87053) Potentials to improve the steam cycle efficiency in an unfired combined cycle.** Bolland, O.; Loeken, P.A. (SINTEF, Trondheim (Norway)). Nov 1987. 20p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88753739/JAW.

The report deals with the potentials to improve the efficiency in a combined cycle. A standard unfired combined cycle is used as a reference process. Some changes are made to the steam cycle to improve the combined cycle efficiency. By decreasing temperature differences and pressure losses, decreasing condenser pressure and using a 3-pressure system instead of the standard 2-pressure, it is possible to improve the net efficiency from 49.62% to 52.56%, which is an increase of 2.94 percentage points. 4 drawings, 1 table.

39612 **(VTT-TIED—834) New alternatives for electricity production. Part 1. Present techniques and development potential of a peat-fired combined cycle condensing power plant.** Solantausta, Y.; Kurkela, E. (Valtion Teknillinen Tutkimuskeskus, Espoo (Finland)). Feb 1988. 81p. (In Finnish). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88753772/JAW.

Development stage and competitiveness of gasification-gas turbine techniques with peat as fuel is discussed. This so-called combined cycle technique is becoming a competitive alternative in coal-based electricity production. Its emissions to the environment are significantly lower than those of conventional techniques. In the study, the present stage and development trends of gasification combined cycle (IGCC) techniques are first surveyed. Then effects of the most significant process parameters related to peat drying and gasification, gas clea-up and gas turbines on the efficiency of the plants are discussed. The material and energy balances of three process concepts are presented. The costs of electricity production with the IGCC techniques are compared to those of conventional techniques. The costs of the presently available IGCC techniques (oxygen gasification of peat, water scrubbing and cold clean-up of gas) are nearly equal to those of the electricity produced in a conventional power plant (<FIM 180/MWh). The efficiency of the IGCC plant is 43% and that of the conventional plant 37%, whilst the annual sulphur oxide emissions of the 150 MW electricity plants are 67 ja 2600 tonnes, respectively. The efficiency of the IGCC techniques under development is estimated at close to 50%, and the production costs of electricity at about FIM 150/MWh. This kind of technique can be technically feasible in the 1990s. The economic competitiveness of the new technique seems to be excellent. The estimated capital requirement may increase by 50%, until the price of electricity reaches the price level of the electricity produced with the present techniques.

39613 **A posturing strategy against voltage instabilities in electric power systems.** Tiranuchit, A.; Thomas, R.J. (Cornell Univ., School of Electrical Engineering, Ithaca, NY (US)). *IEEE Transactions on Power Systems;* 3: No. 1, 87-93(Feb 1988).

The problem of system collapse or blackout characterized by a local severe voltage depression is generally believed to be associated with inadequate VAR support at key busses. The authors proposed the minimum singular value of the Jacobian of the descriptor network equations as a voltage security index. In this paper, the au-

thors discuss techniques for improving the system security with respect to this index. The effect of adding capacitors are examined. They also present a continuation technique that redistributes the system generation to the optimal operating condition with respect to the minimum singular value index.

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REFER ALSO TO CITATION(S) 39093, 39094, 39096, 39599, 40067, 40429, 41231, 41282, 41325, 41326, 41327, 41372

39614 (DOE/EA—0274) Devils Lake main crossing of the Carrington-Devils Lake 115-kV transmission line: Environmental assessment. (USDOE Western Area Power Administration, Boulder City, NV. Boulder City Area Office). May 1985. 22p. NTIS, PC A03/MF A01;3. Order Number DE88010393/JAW.

Planning for the proposed rebuild of the Devils Lake crossing of the Carrington-Devils Lake 115-kV Transmission Line was accomplished in consultation with a number of State and Federal agencies. Western consulted with the North Dakota State Historic Preservation Officer to identify potential significant cultural resources and effects of the project, in compliance with provisions of the National Historic Preservation Act. The FWS was consulted concerning Federally listed threatened and endangered species which the project might affect, pursuant to the Endangered Species Act. FWS and the North Dakota Department of Game and Fish were consulted regarding impacts of the project on fish, wildlife, habitat, and programs of concern to the agencies. The COE was consulted regarding the identification of wetlands in the project area, and the necessity of obtaining permits in accordance with Section 404 of the Clean Water Act and/or Section 10 of the River and Harbor Act of 1899. The US Environmental Protection Agency and North Dakota Department of Health were consulted regarding water quality impacts and the necessity of discharge permits. Prime and other important farmlands in the project area were identified by the soil Conservation Service.

39615 (DOE/PC/91024—T6) Characterization and fundamental studies on CuO sorbent materials to determine attrition mechanisms on substrate gamma alumina: Technical progress report No. 5 for the period September 23-December 23, 1987. Mote, J.D.; Eucker, P.; Naziripour, A.; Zillman, W. (Denver Univ., CO (USA). Dept. of Engineering). 1987. Contract AC22-86PC91024. 10p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88009876/JAW.

The experiments conducted to date indicate that the strength of the sorbent substrate is not greatly affected by the chemical cycling alone. The issue of particle size increase during sorbent cycling has not been satisfactorily resolved to date. The general trend of the data, wherein the sorbent undergoes only absorption-desorption under stationary conditions, is toward a slight increase in particle size with increasing cycles. There is also a slight decrease in strength of the sorbent with increasing absorption-desorption cycles. The decrease in strength could be the result of the increase in particle size. However, if there is an increase in particle size, it may not be due to the absorption-desorption cycling, but could occur due to thermal activation at the process temperature. To date the data suggest that the major factor affecting the strength of the sorbent spheres is the internal pore structure. The morphology of the pores shows that at least the larger ones are somewhat flattened with sharp edges; an ideal fracture source. Furthermore, there is an effect of surface roughness which reduces the mechanical strength of the sorbent and may be similarly related to preexisting cracks at the surface. 3 refs., 7 figs.

39616 (DOE/WP/16151—2) Annual site environmental monitoring report for calendar year 1987. (Sato (J.F.) and Associates, Golden, CO (USA)). 1988. Contract AC65-87WP16151. 43p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88009199/JAW.

The Western Area Power Administraitoon (Western) has established a formal envirnonmental protection, auditing, monitoring, and planning program which has been in effect since 1978. The significant environmental projects and issues Westsern was involved with in 1987 are discussed in this annual site environmental monitoring report. It is written to demonstrate the nature and effectiveness of the environmental protection program. The Department of Energy Order 5481.1, Chapter 3, requires the preparation of an annual site environmental monitoring report. Because Western has numberous facilities located in fifteen states, this report was written to address the environmental activities in all of the facilities as one 'site'.

39617 (ERATL—88/12/XAB) Low-flammability transformer. Dickson, M.R. (ERA Technology Ltd., Leatherhead (UK)). Apr 1987. 93p. (ERA—87-0021). NTIS PC$111.00.

For a number of decades, low-fire-risk transformers for installation in factories, offices, and flats etc. have been either a dry type of transformer in which all materials are non-flammable or a liquid filled type of transformer using askarel polychlorinated biphenyl (PCB) as the liquid. The latter type offered economic and electrical advantages over the dry type of the day. These askarels are no longer in favor and askerel-filled transformers are no longer made. An overview of alternative liquids on sale today is provided. The properties and use of PCB-containing askarels are summarized. For new installations, dry-type transformers are first reviewed. Then liquids which are available in the United Kingdom (UK) for use as transformer impregnants and coolants are surveyed, with in each case information on their composition, properties, handling, flammability, use in transformers and the characteristics of transformers using them, and their suitability as retrofill liquids. The final sections relate to flammability testing of materials and of complete transformers or simulated transformers.

39618 (OH/RD—87/245/K) An R & D [research & development] program on protective coatings used in FGD [flue gas desulfurization] systems. Gowda, G. (Ontario Hydro Research Div., Toronto (Canada)). 14 Dec 1987. 13p. (MICROLOG—88-02027). Ontario Hydro Research Division, Editorial Section, 800 Kipling Ave., Toronto, Ont., Canada M8Z 5S4; $10.00 CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

In compliance with the provincial regulation to reduce acid gas emissions, one of the options Ontario Hydro is considering is the installation of flue gas desulfurization (FGD) scrubbers to control SO/sub 2/ emissions. One of the most serious problems associated with FGD systems has been the failure of construction materials. Abrasion, erosion and corrosion are some of the major causes that contribute to FGD materials failure. The persistent problem with materials failure is partly due to the severe conditions that exist in the scrubber systems, lack of reliable materials performance data, and in some cases, unavailability of the best materials. In view of Ontario Hydro's plan to install scrubber systems for controlling SO/sub 2/ emission, it is essential to establish an in-house FGD materials testing and evaluation program to address potential materials failure problems. The Materials Chemistry Section of the Chemical Research Department has prepared this document proposing such a program. The overall objective of the program is to establish an effective in-house testing, evaluation, problem solving and research capability for FGD systems materials. 9 refs., 2 figs.

39619 (PB—88-191416/XAB) Toxicity of wastes generated by a coal-combustion power plant utilizing limestone-scrubber technology to indigenous aquatic fauna. Final report. Morgan, E.; Young, R.C. (Tennessee Technological Univ., Cookeville (USA). Center for the Management, Utilization and Protection of Water Resources). Jul 1986. 133p. NTIS, PC A07/MF A01.

The risk of trace-element contamination of surface waters by wastes generated in a coal-combustion power plant utilizing limestone-scrubber technology was assessed by evaluating laboratory and site-specific biological and physical-chemical test results. Site-specific results from physical-chemical tests indicated that toxic trace element concentrations were primarily adsorbed onto ash pond suspended and dissolved solids. Treatment (primary settling) of the slurry discharged into the ash pond partially removed toxic fractions of trace-elements from the water column. Complexation, competition, and precipitation of remaining soluble toxic elements

in the ash pond buffered the final effluent's toxicity to indigenous aquatic fauna.

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REFER ALSO TO CITATION(S) 39610, 41325, 41326, 41327, 41328

39620 (CONF-880734—2) Steep-front short-duration voltage surge tests of power line filters and transient voltage suppressors. Barnes, P.R.; Hudson, T.L. (Oak Ridge National Lab., TN (USA)). 1988. Contract AC05-84OR21400. 8p. NTIS, PC A02/MF A01;1; GPO Dep. Order Number DE88006668/JAW.

From IEEE PES summer meeting; Portland, OR, USA (25 Jul 1988).

Steep-front short-duration voltage surge tests were conducted on commercially available single phase industrial-type power line filters in the 120/208 V and 277/480 V class rated at 100 or 200 A and two types of transient voltage suppressors to determine their effectiveness for protection against nuclear electromagnetic pulse (EMP) induced power line transients. The vulnerability of power line filters to the simulated EMP induced surges was also inferred from the test results. It is found that power line filters provide from 38--54 dB of attenuation for steep-front voltage surges (20--40 ns rise time and 150--400 ns fall time to half value waves for 2--20 kV peak voltage), and transient voltage suppressors add an additional 2--8dB of attenuation. It is also found that while power line filters provide good protection against EMP induced surges, degradation of the filter characteristics may occur and delayed failures of filter components are possible. Transient voltage suppressors reduce the EMP induced surge by 40% and thus provide some protection for the filter. 11 refs., 11 figs., 2 tabs.

39621 (EPRI-EL—5668) A 4000-A HVDC [high-voltage direct-current] circuit breaker with fast fault-clearing capability: Final report. (BBC Brown Boveri, Inc., North Brunswick, NJ (USA)). Apr 1988. 98p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88009293/JAW.

This project is a follow-up of the first development of a 500 kV HVDC airblast circuit breaker (EPRI project 1507-3). The objective was to increase the current interrupting capability from 2200 A to 4000 A and shorten its fault clearing time. A high current 500 kV HVDC circuit breaker has been built using the passive commutation circuit. The breaker is modular in construction and can be designed for a wide variety of system conditions. More than 400 current interruptions were carried out successfully. Tests have shown that this circuit breaker is capable of interrupting more than 4000 A dc. Practical breakers with current interrupting capability of even 5500 A dc could be built. The circuit breaker operation and the fault-clearing process can be materially speeded up if the trip signal is given as soon as the fault is detected and without waiting for the current levels to come down in response to converter control action. The new dc breakers are shown to be capable of withstanding these transient arc currents of 8000 A without affecting its ability to interrupt the direct current that follows the transient. This transient current withstand capability is greater than is likely to occur during dc faults. The fault clearing time of this HVDC circuit breaker is comparable to the fault clearing time of conventional ac breakers for ac faults. The developed HVDC circuit breaker is now commercially available and can be supplied for use in HVDC systems. Its use in such systems is expected to provide flexibility in system design and contribute to system stability. 38 refs., 52 figs., 9 tabs.

39622 (EPRI-EL—5757) Thermal overload characteristics of extruded dielectric cables: Final report. Dima, A.; Katz, C.; Eager, G.S. Jr.; Ezrin, M.; Seymour, D.; Johnson, J. (Electric Power Research Inst., Palo Alto, CA (USA); Cable Technology Labs., Inc., New Brunswick, NJ (USA)). Jun 1988. 322p. Unlimited audience, publicly available. Research Reports Center, Box 50490, Palo Alto, CA 94303;1. Order Number TI88012514/JAW.

This report addresses characteristics of thermoset extruded dielectric power cables in the 15--35 kV class, operated under thermal overload conditions. It presents a methodical study to determine the suitability of extruded type cable for operation at elevated temperatures. The results provide utilities with knowledge on the behavior of thermoset insulated cables at temperatures in the 130 to 175{degree}C conductor temperature range. Present industry specifications recommend a maximum emergency conductor temperature of 130{degree}C. The suitability of this temperature and the time it is to be maintained had been questioned. The present report indicates that crosslinked polyethylene and ethylene propylene insulated cable, both new and service aged, are suitable for emergency operation during extended periods at 130{degree}C. When these cables are provided with polyvinyl chloride jackets, long term exposure to temperatures greater than 130{degree}C can adversely affect the integrity of the jacket. Investigations on new cables were performed on short samples in ovens and on long samples in simulated ducts in the laboratory and in a typical utility duct bank. Investigations on cables recovered from service were performed in the laboratory with the cables installed in simulated ducts. 10 refs., 49 figs., 73 tabs.

39623 (EPRI-EL/EA—5443-Vol.3) Analysis of polychlorinated dibenzofurans and polychlorinated dibenzo-p-dioxins in transformers and capacitors: Volume 3, Summary and statistical analysis of the round-robin test: Final report. Pellizzari, E.D.; Perritt, R.; Clayton, C.A.; Hartwell, T.D. (Electric Power Research Inst., Palo Alto, CA (USA); Research Triangle Inst., Research Triangle Park, NC (USA)). Jun 1988. 119p. Unlimited audience, publicly available. Research Reports Center, Box 50490, Palo Alto, CA 94303;3. Order Number TI88011430/JAW.

An interlaboratory study involving five independent laboratories was conducted to quantitatively assess accuracy and precision of polychlorinated dibenzo-p-dioxin (CDD) and polychlorinated dibenzofuran (PCDF) congener analysis in three spiked and seven in-service utility fluids. Data was obtained using capillary gas chromatography/mass spectrometry for 16 different PCDD and PCDF compounds. Five different ^{13}C-labeled internal standards were added to the samples and the samples were purified prior to analysis. Each laboratory's generated calibrations for the individual compounds were linear for concentrations over four orders of magnitude. Analyses were performed in triplicate on an extract to provide insight to instrumental reproducibility. 6 refs., 13 figs., 33 tabs.

39624 (N—88-21374) Power components for the space station 20-kHz power distribution system. Renz, D.D. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). 1988. 10p. (NASA-TM—100866; E—4092; NAS—1.15:100866; CONF-880702—). NTIS, PC A02/MF A01.

From 23. intersociety energy conversion engineering conference; Denver, CO, USA (31 Jul 1988).

Since 1984, NASA Lewis Research Center was developing high power, high frequency space power components as part of The Space Station Advanced Development program. The purpose of The Advanced Development program was to accelerate existing component programs to ensure their availability for use on the Space Station. These components include a rotary power transfer device, remote power controllers, remote bus isolators, high power semiconductor, a high power semiconductor package, high frequency-high power cable, high frequency-high power connectors, and high frequency-high power transformers. All the components were developed to the prototype level and will be installed in the Lewis Research Center Space Station power system test bed.

39625 (OH/RD—87/197/K) Water ingress into power transformers. Executive summary. Gonzalez, L.A. (Ontario Hydro Research Div., Toronto (Canada)). 4 Sep 1987. 13p. (MICROLOG—88-01788). Ontario Hydro Research Division, Editorial Section, 800 Kipling Ave., Toronto, Ont., Canada M8Z 5S4; $10.00 CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

A comprehensive study of water migration in power transformers was carried out using transport and thermodynamic equations. A mathematical model which describes moisture equilibrium distribution in a 750 MVA unit was developed. This model was subsequently used to calculate moisture equilibrium content in the

insulating materials at different environmental conditions typical for Ontario. It was established that moisture in the solid insulation (paper, pressboard and wood) and insulating materials degradation reactions are the most important sources of water in the unit. Although open to the atmosphere, there is essentially no transfer of moisture between the oil in the unit and ambient. This is a direct consequence of the low diffusivity of water in insulating oil, the relative long diffusion path and the rather low moisture concentrations involved. Water condensation, a phenomenon commonly observed in in-service units, is expected to occur in highly humid transformers continuously exposed to swings in temperature. Because of the impact that these findings may have in maintenance practices of power transformers, it is recommended that these should be confirmed by an experimental study. 7 refs., 1 fig., 5 tabs.

39626 **(OH/RD—87/230/K) Overhead conductor capacity studies 4. Interpretation of 1986 summer data.** Chisholm, W.A.; Barrett, J.S. (Ontario Hydro Research Div., Toronto (Canada)). 1 Dec 1987. 20p. (MICROLOG—88-02034). Ontario Hydro Research Division, Editorial Section, 800 Kipling Ave., Toronto, Ont., Canada M8Z 5S4; $10.00 CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

The Bulk Electrical System in Ontario contains many older circuits that have a maximum conductor temperature limit of 49/sup 0/C. A program of measurements and modeling has been initiated to allow best use of these lines during summer peak-load conditions. Misapplication of the ruling-span approximation to lines with unequal span lengths leads to errors in sag changes with temperature. These errors could require derating of lines like the Essa Test Line from 49/sup 0/C to 40/sup 0/C. Predictions of conductor temperature based on Out-Of-Limits Monitoring (OOLM) weather data are usually higher than observed. However, OOLM predictions were too low by more than 4/sup 0/C on 37 of 864 test hours. Of the 37 periods, 13 were day-light hours with the worst cases having conductor temperatures of 39-41/sup 0/C and an OOLM-based predictions of 30-36/sup 0/C. 11 refs., 12 figs.

39627 **(OH/RD—87/237/K) Measurements of the effect of a 115-kV transmission line on the electric magnetic field environment in and around a public school.** Harvey, S.M. (Ontario Hydro Research Div., Toronto (Canada)). 27 Oct 1987. 28p. (MICROLOG—88-01743). Ontario Hydro Research Division, Editorial Section, 800 Kipling Ave., Toronto, Ont., Canada M8Z 5S4; $10.00 CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

In response to a request from the Waterloo (Ontario) Country School Board, electric and magnetic fields produced by a double-circuit 115-kV transmission line in and around a new public school adjacent to the line were measured. Measurements were also made to compare the power-frequency magnetic field environment at this school with the power-frequency magnetic field environment at this school with the power-frequency magnetic field environment of an old school located some distance from the line. The electric and magnetic field environments are well below all present and projected guidelines and are within the range expected in and around typical residential or institutional buildings. The magnetic field levels are determined mainly by the low-voltage school wiring. In particular, the tranmission line adjacent to the new school had no significant effect on either the range or the complexity of the magnetic field environment at the new school in comparison with the older one. 5 refs., 10 figs., 8 tabs.

39628 **(OH/RD—87/253/K) Frost heave monitoring of test footings at selected transformer stations.** Vorauer, A. (Ontario Hydro Research Div., Toronto (Canada)). 27 Nov 1987. 35p. (MICROLOG—88-01734). Ontario Hydro Research Division, Editorial Section, 800 Kipling Ave., Toronto, Ont., Canada M8Z 5S4; $10.00 CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

Several transformer stations across Ontario have reported heaving of light equipment foundations. To assess remedial designs, four types of test footings were installed and monitored at Port Hope, Ottawa Hawthorne and Pinard Transmission Stations. Disturbed soil samples from each site were brought to the laboratory and tested for frost susceptiblity. Results from the laboratory testing indicate that all the soils are frost susceptible to some degree and that soil heave could be reduced by increasing its compacted density. Results of the field monitoring indicate that the winter of 1986-1987 was much warmer than normal, leading to less frost penetration and ground heave. The field study involved installing four types of test footings (shaft/sleeve, augered, insulated and screw-in) at the three transformer stations. In addition, several sets of frost depth and frost heave gauges were installed in the vicinity of the footings to monitor ground response to freezing temperatures. Gauge readings and surveys were made on a monthly basis to provide field data for analysis. The most useful data, obtained from Pinard, indicate that the shaft/sleeve footing heaved less than others. It is recommended that the monitoring program be repeated for the winter of 1987-1988 and that readings be taken on a bi-weekly basis from mid-October to late April. 2 refs., 22 figs., 4 tabs.

39629 **(OH/RD—87/258/K) Ottawa-Hawthorne TS [Transmission Station] T/R [thermal/resistivity] survey.** Radhakrishna, H.S. (Ontario Hydro Research Div., Toronto (Canada)). 22 Oct 1987. 10p. (MICROLOG—88-01740). Ontario Hydro Research Division, Editorial Section, 800 Kipling Ave., Toronto, Ont., Canada M8Z 5S4; $10.00 CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

In-situ and laboratory measurements of the soil thermal resistivity were made along the proposed underground cable route inside Hawthorne Transmission Station (Ontario). The soil types encountered were silty sand and clayey silt. The ground water table was within one meter depth and the soils were generally wet. In-situ thermal resistivity values ranged from 60/sup 0/C cm/W to 80/sup 0/C cm/W. Based on the statistical weather data analysis and neglecting the presence of the ground water table, the worst case thermal resistivity of 100/sup 0/C cm/W is recommended to be used for the native soil in the ampacity calculations. 5 figs., 2 tabs.

39630 **(OH/RD—87/298/K) Clairville TS [Transmission Station] to Vaughan MTS U/G Cable Thermal Resistivity Survey.** (Ontario Hydro Research Div., Toronto (Canada)). 2 Dec 1987. 5p. (MICROLOG—88-02031). Ontario Hydro Research Division, Editorial Section, 800 Kipling Ave., Toronto, Ont., Canada M8Z 5S4; $10.00 CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

In-situ and laboratory measurements of the soil thermal resistivity were made for the proposed underground cable portion of a transmission line in Ontario. The soil types encountered were moist clayey silt and silty clay. The ground water table was not encountered within the depth of sampling and in-situ measurements (1.5 m). In-situ thermal resistivity values ranged from 60 to 90/sup 0/C cm/W. Based on the statistical analysis of 50 year weather data, the worst case thermal resistivity of 120/sup 0/C cm/W is recommended to be used for the native soil in the ampacity calculations and the design of cable thermal backfill. 1 fig., 1 tab.

39631 **A two-port equivalent model for a transmission line with distributed sources.** Palchefsky, J.W. Jr. (GE/Re-Entry Systems Dept., 3198 Chestnut St., Philadelphia, PA (US)). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* **NS-34**: No. 6, 1488-1493(Dec 1987). (CONF-8707112—).

From Annual conference on nuclear and space radiation effects; Snowmass Village, CO, USA (28 Jul 1987).

The theory of a transmission line with distributed sources is useful in the analysis of electromagnetic pulse coupling to shielded cables and in the analysis of system generated electromagnetic pulse. To facilitate computer simulations of cable surges induced by these nuclear environments, a new two port equivalent source model for a uniform, time invariant transmission line with independent distributed sources is presented. The equivalent source model is based on a newly recognized circuit synthesis of the boundary conditions imposed by the line's reflection coefficient and

requires only the solution of the matched-load termination responses. This model greatly simplifies the algebra required by previously published techniques. The model is compact, requiring only six nodes for a mathematically precise simulation, and it should prove useful in the assessment of interface cable surge threats in electrical systems where large numbers of circuits need to be evaluated with some precision. As with earlier techniques, this model is valid in the frequency domain with linear load terminations and dispersive, lossy transmission line propagation parameters. The Fourier spectra of linear load responses are readily formulated for numerical inversion to the time domain. For the lossless line or the distortionless lossy line, a time domain source model is derived here for efficient, time-saving use with computer circuit analysis programs containing passive two port transmission line models. Loads in this case can be non-linear.

39632 **Power system monitoring with state vector measurement.** Phadke, A.G.; Thorp, J.S.; Karimi, K.J. (Virginia Polytechnic Institute and State Univ. (US)). pp 124-129 of Proceedings of the 2nd international conference on power system monitoring and control. Piscataway, NJ; IEEE Service Center (1986). (CONF-8607328—).

From 2. international conference on power monitoring and control; Durham, UK (8 Jul 1986).

This paper concentrates upon phases of phasor measurements in static state estimation. It addresses the problem of interfacing a phasor based state estimator with an existing state estimator based upon conventional measurements.

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REFER ALSO TO CITATION(S) 39771, 39834, 42080, 42081

39633 **(DOE/NE—0091) Phase 9 update (1987) report for the Energy Economic Data Base Program EEDB-IX.** (United Engineers and Constructors, Inc., Philadelphia, PA (USA)). Jul 1988. Contract AC05-84OR21400. 265p. NTIS, PC A12/MF A01; 1; GPO Dep. Order Number DE88013033/JAW.

This document is a review of the 1987 update of detailed reference powerplant cost estimates. This distribution is the latest in a series published since 1978. The overall program purpose is to provide periodically updated, detailed base construction cost estimates for large nuclear electric operating plants. These data, which are representative of current US powerplant construction cost experience, are a useful contribution to program planning by the Office of the Assistant Secretary for Nuclear Energy. The ninth update includes three new models as a basis for projecting future costs of both small and large nuclear power plants and examining the potential for cost reduction by incorporation of improved and advanced design features. The models designated as improved include the advantages of modular construction and standardized approach to design and construction. The advanced model includes many of the features of the improved data models as well as application of passive or near-passive safety systems and design simplification.

39634 **(IAEA-TECDOC—458) OSART results. A summary of the results of Operational Safety Review Team missions during the period August 1983 to May 1987.** (International Atomic Energy Agency, Vienna (Austria)). Apr 1988. 130p. NTIS (US Sales Only), PC A07/MF A01. Order Number DE88703148/JAW.

The IAEA Operational Safety Review Team (OSART) programme provides advice and assistance to Member States for enhancing the operational safety of nuclear power plants. OSART reviews are available to all countries with nuclear power plants in operation or approaching operation. Most of these countries have participated in the programme, by hosting one or more OSART missions or by making experts available to participate in missions. The observations of the OSART members are documented in technical notes which are then used as source material for the official OSART Report submitted to the government of the host country. The technical notes contain recommendations for improvements and descriptions of commendable good practices. The same notes have been used to compile the present summary report which is intended for wide distribution to all organizations constructing, operating or regulating nuclear power plants. This document presents significant observations made by OSART missions during the period August 1983 to May 1987. The most significant concerns and recommendations are listed in the first part. In the second part, we discuss in detail the findings of OSART missions in eight subject areas. It is hoped that operators - especially those of plants which have not yet been visited by review teams - will take note. The safety record of the nuclear industry is only as good as that of its weakest plant.

39635 **(INIS-mf—11243) Accuracy requirements on operational measurements in nuclear power plants with regard to balance methodology.** Holecek, C. (Ceskoslovenska Vedeckotechnicka Spolecnost, Prague. Dum Techniky). 1986. 6p. (In Czech). (CONF-8606407—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88703057/JAW.

From 12. national seminar on measurements in power engineering; Zdar nad Sazavou, Czechoslovakia (9 Jun 1986).

Published in seminar proceedings "Metrologie jadernych elektraren", p. 14-19.

Accurate in-service measurement is necessary for power balancing of nuclear power plants, i.e., the determination of fuel consumption, electric power generation, heat delivery and the degree of fuel power utilization. The only possible method of determining the input of total consumed energy from the fuel is the balance of the primary coolant circuit. This is because for the purposes of power balancing it is not possible to measure the amount of power generated from nuclear fuel. Relations are presented for the calculation of basic indices of the power balance. It is stated that for the purposes of power balancing and analyses the precision of measuring instrument at the input and output of balancing circuits is of primary importance, followed by the precision of measuring instruments inside balancing circuits and meters of auxiliary parameters. (Z.M.). 7 refs., 1 tab.

39636 **(NUREG—0020-Vol.12-No.4) Licensed operation reactors: Status summary report: Datn as of March 31, 1988.** Schwartz, I. (Nuclear Regulatory Commission, Washington, DC (USA). Office of Administration and Resources Management). Apr 1988. 510p. NTIS, PC A22/MF A01 - GPO;1. Order Number TI88010428/JAW.

This report is divided into three sections: the first contains monthly highlights and statistics for commercial operating units, and errata from previously reported data; the second is a compilation of detailed information on each unit, provided by NRC Regional Offices, IE Headquarters and the Utilities; and the third section is an appendix for miscellaneous information such as spent fuel storage capability, reactor years of experience and non-power reactors in the United States. It is hoped this status report proves informative and helpful to all agencies and individuals interested in analyzing trends in the nuclear industry which might have safety implications, or in maintaining an awareness of the US energy situation as a whole.

39637 **Aging of concrete components and its significance relative to life extension of nuclear power plants.** Naus, D.J. (Oak Ridge National Lab., TN (USA)). pp 229-234 of Transactions of the 9th international conference on structural mechanics in reactor technology. Vol. D. Experience with structures and components in operating reactors. Wittmann, F.H. (ed.). Rotterdam, Netherlands; Balkema (1987). (CONF-870812—). Contract AC05-84OR21400.

From 9. SMIRT: international conference on structural mechanics in reactor technology; Lausanne, Switzerland (17 Aug 1987).

Nuclear power currently supplies about 16% of the U.S. electricity requirements, with the percentage expected to rise to 20% by 1990. Despite the increasing role of nuclear power in energy production, cessation of orders for new nuclear plants in combination with expiration of operating licenses for several plants in the next 15 to 20 years results in a potential loss of electrical generating capacity of 50-60 gigawatts during the time period 2005 to 2020. A potential timely and cost-effective solution to the problem of meeting future energy demand is available through extension of the service life of existing nuclear plants. Any consideration of plant life extension, however, must consider the concrete compo-

nents in these plants since they play a vital safety role. Under the USNRC Nuclear Plant Aging Research (NPAR) Program, a study was conducted to review operating experience and to provide background that will lead to subsequent development of a methodology for assessing and predicting the effects of aging on the performance of concrete-based structures. The approach followed was in conformance with the NPAR strategy (Morris and Vora 1985).

39638 **Trend and pattern analysis of failures of main feedwater system components in United States commercial nuclear power plants.** Gentillon, C.D.; Meachum, T.R.; Brady, B.M. (Idaho National Engineering Lab., Idaho Falls (USA);Nuclear Regulatory Commission, Washington, DC (USA). Office for Analysis and Evaluation of Operational Data). pp 299-304 of Transactions of the 9th international conference on structural mechanics in reactor technology. Vol. D. Experience with structures and components in operating reactors. Wittmann, F.H. (ed.). Rotterdam, Netherlands; Balkema (1987). (CONF-870812—). Contract AC07-76ID01570.

From 9. SMIRT: international conference on structural mechanics in reactor technology; Lausanne, Switzerland (17 Aug 1987).

The goal of the trend and pattern analysis of MFW (main feedwater) component failure data is to identify component attributes that are associated with relatively high incidences of failure. Manufacturer, valve type, and pump rotational speed are examples of component attributes under study; in addition, the pattern of failures among NPP units is studied. A series of statistical methods is applied to identify trends and patterns in failures and trends in occurrences in time with regard to these component attributes or variables. This process is followed by an engineering evaluation of the statistical results. In the remainder of this paper, the characteristics of the NPRDS that facilitate its use in reliability and risk studies are highlighted, the analysis methods are briefly described, and the lessons learned thus far for improving MFW system availability and reliability are summarized

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REFER ALSO TO CITATION(S) 39274, 39717, 39772, 39774, 39789, 39796, 39806, 39811, 39813, 39815, 39822, 39823, 39825, 39826, 39827, 39837, 39845, 39848, 39853, 39855, 39867, 39868, 39871, 39883, 39887, 39888, 39895, 39900, 39916, 39917, 39922, 39926, 39934, 39935, 39936, 39938, 39942, 39948, 39949, 39950, 39954, 39960, 39961, 39965, 40266, 40285, 41253, 42543

39639 **(EPRI-NP—5209-SR) Surface treatments to reduce radiation fields: Test-loop studies and plant demonstrations.** Ocken, H. (Electric Power Research Inst., Palo Alto, CA (USA). Nuclear Power Div.). Apr 1988. 196p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88009445/JAW.

This report reviews surface treatments that have been evaluated in laboratory loop, plant loop, and in-plant systems to reduce radiation field buildup on reactor components. Recent experiments in laboratory loop facilities are emphasized. The surface treatment methods and ^{60}Co pickup measurements under both BWR and PWR coolant chemistry conditions are described. It was found that an electroless deposit of palladium offers exceptional resistance to incorporation of ^{60}Co. EPRI is focusing on developing techniques for depositing such films on engineering-scale components. In-plant measurements have shown that electro-polishing and preoxidation under properly selected conditions are effective in reducing recontamination of BWR recirculation piping.

39640 **(EPRI-NP—5722) Chemical decontamination of BWR [boiling water reactor] fuel and core materials: On-site decontamination: Final report.** Gerdingh, R.F.; Turner, V.C.; Smee, J.L.; Lipnicky, R.H.; Beaman, T.A.; Miller, S.G.; Dickherber, R.L.; O'Boyle, D.R.; Sirovy, J.E.; Weinfurter, E.B.; Bucciferro, J.P.; Conroy, K.W. (Electric Power Research Inst., Palo Alto, CA (USA)). Apr 1988. 103p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88009444/JAW.

As part of the on-going EPRI research program to control radiation fields in LWRs, decontamination processes for use on core materials are being qualified. In this project, two BWR fuel assemblies were chemically decontaminated, one each with the AP/CAN-DECON and AP/LOMI processes. Both assemblies had been irradiated for three fuel cycles in the Quad Cities Nuclear Station. The primary objective was to study the effects of commercially available decontamination reagents on fuel assembly materials. A secondary objective was to show that these reagents can effectively remove crud deposits from fuel surfaces. In addition, CERT specimens made from an irradiate dcontrol blade were exposed to the decontamination reagents to look for indications of irradiation assisted SCC or other types of corrosion.

39641 **(EPRI-NP—5808) BWR [boiling water reactor] cobalt deposition studies: Final report.** Lin, C.C.; Smith, F.R. (Electric Power Research Inst., Palo Alto, CA (USA); General Electric Co., San Jose, CA (USA). Nuclear Energy Div.). May 1988. 201p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88010647/JAW.

Cobalt deposition on stainless steel surfaces under various water chemistry conditions has been thoroughly investigated. Parameters studied include the dissolved O_2, water conductivity, pH, metallic and organic additives, and surface treatments. Additionally, selected samples were analyzed for the oxide film characterization. The experimental data have been carefully evaluated, and three major deposition mechanisms are proposed to explain the variation of the experimental data. It is concluded that the controlling factors for the Co-60 radiation buildup on the BWR system pipings are now much better understood. Some remedies and operation practices to control the Co-60 radiation buildup in BWRs are identified.

39642 **(EPRI-NP—5809) Effects of liquid droplets on fuel-to-fluid heat transfer in rod bundles with and without blockages: Final report.** Kianjah, H.; Dhir, V.K. (California Univ., Los Angeles (USA). Dept. of Mechanical, Aerospace and Nuclear Engineering). May 1988. 117p. Research Reports Center, Box 50490, Palo Alto, CA 94303;1. Order Number TI88010464/JAW.

Experimental studies of dispersed flow heat transfer in a four rod bundle with and without blockages have been carried out by entraining glass particles in air. In the range of parameters studied the data show a definite enhancement in heat transfer under entrained flow conditions. The magnitude of enhancement is found to depend on the size and volume fraction of the entrained particles.

39643 **(EPRI-NP—5827-SR) A proof-of-concept transient diagnostic expert system for BWRs [Boiling Water Reactors].** Yoshida, K.; Naser, J.A. (Electric Power Research Inst., Palo Alto, CA (USA)). May 1988. 160p. /MF A01 - Research Reports Center, Box 50490, Palo Alto, Ca 94303;1. Order Number TI88010463/JAW.

A proof-of-concept transient diagnostic expert system has been developed to identify the cause and the type of an abnormal transient in a boiling water nuclear power plant. For this expert system development, the calculational results of the simulation code RETRAN were used as the knowledge source. The knowledge extracted from the RETRAN analyses was transformed into IF-THEN rules in the knowledge base for the expert system. An important feature of this expert system is the introduction of certainty factors to allow diagnosis even in the cases where data may be either missing or marked as invalid. To increase the capability of this diagnostic system to distinguish between similiar transients, backward chaining reasoning is used to support the forward chaining reasoning with certainty factors. Through this effort, it has been demonstrated that an expert system can be successfully used to create a transient diagnostic system. It has also successfully demonstrated that RETRAN can be used as the knowledge source for developing the knowledge base of the diagnostic system.

39644 **(EPRI-NP—5864) Influence of forward-pumped heater drains and magnetic filtration on water chemistry and radiation buildup in BWRs: Final report.** Wegemar, B. (Electric Power Research Inst., Palo Alto, CA (USA); ABB ATOM AB, Vaesteras (Sweden)). Jun 1988. 110p. Unlimited audience, publicly available. Research Reports Center, Box 50490, Palo Alto, CA 94303;1. Order Number TI88011694/JAW.

Operating experiences from the Forsmark 3 and Oskarshamn 3 BWRs have been evaluated during the first two cycles of their operation. The objective of this work was to determine the influence on water chemistry quality and radiation field buildup from the special design characteristics of these plants. Important differences from older ASEA-ATOM BWRs include the concept of forward pumped high pressure heater drains, magnetic filtration of high pressure drains and use of more erosion-resistant materials in turbine components. Data obtained from water radiochemistry measurements, shutdown dose rates and gamma scanning surveys, fuel deposit analyses and occuptional exposure statistics have been used in order to enable a comparsion to older ASEA-ATOM BWRs. At the end of the second cycles, satisfactory feedwater quality was reported in both plants. Radiation levels around components in the primary systems are higher in Forsmark 3 and Oskarshamn 3 as compared to other plants. This is in agreement with reactor water activities, fuel deposits and gamma scanning surveys, indicating somewhat higher amounts of cobalt-60 and cobalt-58. However, in both plants occupational exposures were low during the first two years of operation.

39645 **(NUREG/CR—4082-Vol.6) Degraded piping program: Phase II: Sixth program report, October 1986--September 1987.** Wilkowski, G.M.; Ahmad, J.; Barnes, C.R.; Brust, F.; Ghadiali, N.; Guerrieri, D.; Kramer, G.; Landow, M.; Marschall, C.W.; Nakagaki, M.; Olson, R.; Papaspyropoulos, V.; Rosenfeld, M.; Scott, P. (Battelle Columbus Div., OH (USA)). Apr 1988. 331p. (BMI—2120-Vol.6). NTIS, PC A15/MF A01 - GPO;1. Order Number TI88009209/JAW.

Presented herein is an Annual Report of the US NRC's Degraded Piping Program---Phase II. This is the sixth program report on this program. Prior reports were semiannual reports. The intent of this program is to experimentally validate and enhance available analytical methods for evaluating the mechanical behavior of nuclear power plant piping containing circumferentially oriented defects. Fifty-seven pipe experiments have been conducted to date. These and approximately fifty additional pipe experiments from other programs have been analyzed. In the analytical effort, a screening criterion has been developed to show when the net-section-collapse analysis is valid. This shows that even though materials such as stainless steel can fail at less than net-section-collapse loads if the pipe diameter is sufficiently large. Numerous predictive J-estimation schemes have been evaluated and modified. A finite length surface-cracked pipe estimation scheme has also been developed and incorporated into a computer code called NRCPIPE. This code provides a convenient way of analyzing cracked pipe with a number of currently accepted analytical methods. Supporting research efforts involve investigating geometry effects on J-R curves, as well as characterizing the material properties for each pipe tested. The significance of all of the efforts to date relative to pipe fracture analyses and flaw assessment criteria are discussed.

39646 **(NUREG/CR—5160) Guidelines for the use of the Energy Economic Data Base (EEDB) at the sub-component and subsystem level: Final report.** Robinson, T.; Simion, G.; Sciacca, F.; Claiborne, E.; Watlington, B.; Riordan, B.; Godfrey, P. (Nuclear Regulatory Commission, Washington, DC (USA)). May 1988. 67p. NTIS, PC A04/MF A01 - GPO;1. Order Number TI88011820/JAW.

The Energy Economic Data Base (EEDB) provides complete plant construction cost estimates for boiling water reactors (BWRs) and pressurized water reactors (PWRs). The generic cost estimating methods developed for the Nuclear Regulatory Commission (NRC) utilize the EEDB cost data as a basis for estimating the costs of physical modifications to nuclear plants. Such modifications may be mandated by new or revised NRC regulatory requirements. The costs presented in the EEDB are often given at a relatively high level of aggregation. The definition of material, labor, and equipment costs is seldom given at the same level as that encountered in plant modification projects. Additional definition is needed to adequately estimate the costs of many proposed changes. This report presents material and equipment costs and labor manhours/costs at the component, subcomponent, and subsystem level that support and correspond to the more highly aggregated data presented in the EEDB. It is intended to be a supplement to the EEDB. Specifically, unit labor and material/equipment costs are defined for the following types of materials and equipment: rotating machinery, piping and piping related commodities (piping, valves, hangers, and insulation), instrumentation and control, lighting and service power, and skid mounted equipment. 4 refs., 1 fig., 7 tabs.

39647 **(STUK-B-YTO—46) Operation of Finnish nuclear power plants. Quarterly Report, Second Quarter, 1987.** (Finnish Centre for Radiation and Nuclear Safety, Helsinki). Apr 1988. 28p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88754093/JAW.

This general review of the operation of the Finnish nuclear power plants concentrates on such events and discoveries related to nuclear and radiation safety as the regulatory body, the Finnish Centre for Radiation and Nuclear Safety, regards as noteworthy. The report also includes a summary of the radiation safety of the personnel and the environment, as well as tubulated data on the production and load factors of the plants. In the report period, no event essentially degraded plant safety nor posed a radiation hazard to the personnel or the environment.

39648 **Conceptual development of a complete LWR reload design methodology based on generalized perturbation theory.** White, J.R. Knoxville, TN; Univ. of Tennessee (1986). 137p. University Microfilms Order No. 87-13,490.

Thesis (Ph. D.).

A new approach for the physics design and analysis of LWR reload cores is developed and demonstrated through several practical applications. The new design philosophy uses first- and second-order response derivatives to predict the important reactor performance characteristics (power peaking, reactivity coefficients, etc.) for any number of possible material configurations (assembly shuffling and burnable poison loadings). The response derivatives are computed using generalized perturbation theory (GPT) techniques. This report describes in detail an idealized GPT-based design system. The idealized system would contain individual modules to generate the required first-order and higher-order sensitivity data. It would also contain at least two major application codes; one for core design optimization and the other for evaluation of several safety parameters of interest in off-normal situations. This ideal system would be fully automated, user-friendly, and quite flexible in its ability to provide a variety of design and analysis capabilities. Information gained form these three studies gives a good foundation for the development of a complete integrated design package.

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REFER ALSO TO CITATION(S) 39274, 39639, 39642, 39645, 39646, 39647, 39648, 39705, 39717, 39722, 39725, 39730, 39757, 39759, 39766, 39767, 39769, 39774, 39775, 39776, 39783, 39785, 39789, 39796, 39802, 39803, 39806, 39810, 39811, 39812, 39813, 39814, 39815, 39816, 39817, 39818, 39819, 39820, 39821, 39822, 39823, 39824, 39825, 39827, 39831, 39832, 39837, 39846, 39848, 39849, 39850, 39852, 39853, 39854, 39856, 39858, 39859, 39862, 39863, 39864, 39865, 39867, 39869, 39871, 39872, 39880, 39883, 39887, 39890, 39891, 39892, 39893, 39894, 39896, 39897, 39901, 39902, 39903, 39904, 39905, 39906, 39907, 39908, 39909, 39910, 39911, 39912, 39913, 39914, 39915, 39916, 39917, 39921, 39923, 39925, 39926, 39927, 39931, 39932, 39934, 39936, 39939, 39941, 39942, 39944, 39945, 39946, 39947, 39948, 39949, 39950, 39951, 39953, 39954, 39955, 39956, 39959, 39960, 39961, 39964, 39967, 40035, 40285, 40286, 40287, 40713, 42082, 42542, 42543

39649 **(CEA-DAS—307) Reliability analysis with the simulator S.ESCAF of a very complex sequential system: the electrical power supply system of a nuclear reactor.** Blot, M.; Laviron, A. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. d'Analyse de Surete). Jun 1987. 11p. (CONF-861027—). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88752455/JAW.

From 5. international conference on reliability and maintainability; Biarritz, France (6 Oct 1986).

The reliability analysis of complex sequential systems, in which the order of arrival of the events must be taken into account, can be very difficult, because the use of the classical modelling technique of Markov diagrams leads to an important limitation on the number of components which can be handled. The desk-top apparatus S.ESCAF, which electronically simulates very closely the behaviour of the system being studied, and is very easy to use, even by a non specialist in electronics, allows one to avoid these inconveniences and to enlarge considerably the analysis possibilities. This paper shows the application of the S.ESCAF method to the electrical power supply system of a nuclear reactor. This system requires the simulation of more than forty components with about sixty events such as failure, repair and refusal to start. A comparison of times necessary to perform the analysis by these means and by other methods is described, and the advantages of S.ESCAF are presented.

39650 **(CEA-DAS—375) Aging influence on behavior of electrical cable in a PWR's containment building.** Henry, J.Y.; Melet, G.; Carlin, F. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. d'Analyse de Surete). Jun 1987. 20p. (In French). (CONF-870604—). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88752407/JAW.

From International symposium on safety aspects of the aging and maintenance of nuclear power plants; Vienna, Austria (29 Jun 1987).

In this paper the authors give the results of experience of aging under radiation for Hypalon and EPDM used in electrical cables. The evolution of mechanical and chemical properties has been followed for emission rate of 320 μ GyS/sup -1/ to 1.4 GyS/sup -1/, for doses until 180 kGy.

39651 **(CEA-DAS—376) Reactor containment depressurization and filtration equipment for use in the case of a serious accident.** L'Homme, A.; Royen, J. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. d'Analyse de Surete). Jun 1987. 12p. (In French). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88752405/JAW.

A study was carried out under the aegis of the OECD into filtered vented containment systems which permit depressurization of the containment and filtration of the effluents released to the environment, in the event of a major accident with a pressurized water reactor (PWR) (or BWR or CANDU type reactors) involving core meltdown, with a view to minimizing the consequences. This paper describes the various systems examined which could possibly be used for this purpose. These comprised the French robust sand filtration system, the Swedish FILTRA system, the vacuum containment and discharge and emergency filtration system used by the CANDU plants of the Ontario-Hydro electricity company in Canada and the BWR pressure-suppression pounds. The positions of the various national authorities regarding incorporation of such systems into nuclear power plants, the design and technical principles underlying the systems, the procedures and criteria for their use and their advantages and disadvantages are examined.

39652 **(CNEN-DR-NT—02/87) Regulatory guides for qualifying the calculation methodology of Furnas by CNEN.** (Comissao Nacional de Energia Nuclear de Brasil, Rio de Janeiro. Dept. de Reatores). Oct 1987. 10p. (In Portuguese). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88701549/JAW.

Regulatory guides are presented which will be used for qualifying the calculation methodology of FURNAS by CNEN, in the areas of Neutronics, Thermohydraulics, Accident Analysis and Fuel Rod Performance, as applied to Angra 1 NPP.

39653 **(CNIC—00052) Practical method for optimization of fuel management of PWR.** Wu Yuan; Tang Yuren. (China Nuclear Information Centre, Beijing, BJ). 1987. 13p. (In Chinese). (BINE—0002). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702634/JAW.

A practical method for simulation of fuel management optimization of PWR cores with two-dimensional model is described. The general objective of the optimization is to choose a set of refuelling arrangement schemes, which will produce the maximum economic profit on condition that it meets the safety criteria of PWR. It oftern requires quite a lot of computer time to simulate the optimized schemes. An effective and acceptable optimization strategy, two-step search method, has been developed. The first step of algorithm consists of several approaches based on the information avilable and the past experiences with refuelling. The second step allows a further improvement of the previously determined optimum schemes. The maximum radial power peaking factor, W/sub p/, is defined as the objective function. Several physical criteria are examined to propose the constraints. The main intention is to minimize, the objective function W/sub p/, subjected to various constraints. Hence a computer program, 2DFEOF in FORTRAN 77, was developed. Some calculations were done for a typical PWR core on an IBM-4341 computer. The satisfactory results were obtained at reasonable low computational costs. It spent nearly 9 mins CPU time for 3 fuel cycles with a 1/8 core configuration.

39654 **(EPRI-NP—5557-Vol.2) ATHOS3 computer code verification: Volume 2, 0.95-scale test: Final report.** Lee, A.Y.; Masiello, P.J. (Electric Power Research Inst., Palo Alto, CA (USA)). Jun 1988. 168p. Unlimited audience, publicly available. Research Reports Center, Box 50490, Palo Alto, CA 94303;1. Order Number TI88011937/JAW.

As Part II of the EPRI Research Project S-310-8 for ATHOS3 code verification applications, the December 1985 version of the ATHOS3 code was used to analyze the flow field in the 0.95 scale test model of the Westinghouse Model D4 steam generator preheater. The test model is a 90{degree} segment of the preheater region consisting of the entire five flow passes in the preheater. The experiments were conducted using ambient air as the working fluid. Tube surface velocities at tube Row 49, Passes 1, 2 and 3, tube Row 47, Pass 1 and at the back of the T-slot of the tube bundle were measured and compared with ATHOS3 predictions. ATHOS3 analysis models in both cylindrical and Cartesian coordinate systems were prepared. Coefficients in the correlations for friction factor and turbulence effective viscosity were varied in the calculations. Pressure differentials between various locations inside the test model were also measured and compared with code predictions. The results of the code verification with the test data are presented in this report.

39655 **(EPRI-NP—5565) Vibration and wear prediction for steam generator tubes: Final report.** Rao, M.S.M.; Gupta, G.D.; Eisinger, F.L. (Electric Power Research Inst., Palo Alto, CA (USA)). Jun 1988. 205p. Unlimited audience, publicly available. Research Reports Center, Box 50490, Palo Alto, CA 94303;3. Order Number TI88011927/JAW.

As part of the overall EPRI program to develop a mechanistic model for tube fretting and wear prediction, Foster Wheeler Development Corporation undertook the responsibility of developing analytical models to predict structural response and wear in a multispan tube. The project objective was to develop the analytical capability to simulate the time-dependent motion of a multispan steam generator tube in the presence of the clearance gaps at each tube baffle or support. The models developed were to simulate nonlinear tube-to-tube support interaction by determining the impact force, the sliding distance, and the resultant tube wear. Other objectives of the project included: validate the models by comparing the analytical results with the EPRI tests done at Combustion Engineering (C-E) on single multispan tubes; test the models for simulating the U-bend region of the steam generator tube, including the antivibration bars; and develop simplified methods to treat the nonlinear dynamic problem of a multispan tube so that computing costs could be minimized. 15 refs., 53 figs., 27 tabs.

39656 **(EPRI-NP—5733) Pressure vessel neutron dosimetry at three PWRs [Pressurized Water Reactors]: Final report.** Cogburn, C.O.; Williams, J.G. (Arkansas Univ., Fayetteville (USA). Dept. of Mechanical Engineering). Apr 1988. 97p. /MF A05 - Research Reports Center, Box 50490, Palo Alto, CA 94303;1. Order Number TI88009894/JAW.

A series of neutron dosimetry experiments has been performed at three Pressurized Water Reactor plants, representing each of the three US PWR vendors. The study has included analysis of several sets of radiometric monitors irradiated in the pressure vessel cavity of each reactor, as well as monitors from in-vessel positions. In each case, measurements have been compared with transport calculations performed by the University of Missouri (Rolla) research team. Other labs have performed both independent measurements and calculations, in verification, and the NBS has provided fluence calibrations. The aim of this research project has been to provide benchmark data and methodology for pressure vessel surveillance. The study has been underway for over 7 years and has covered several fuel cycles, various operational conditions and different axial and azimuthal positions relative to the pressure vessels. Dosimetry results from each reactor are included and compared with calculations.

39657 **(EPRI-NP—5802) Method for detecting resin leakage in LWR coolant.** Girard, J.E. (American Univ., Washington, DC). May 1988. 87p. Research Reports Center, Box 50490, Palo Alto, CA 94303;1. Order Number TI88009303/JAW.

Resin leakage from condensate polishing units can result in steam generator corrosion. This report describes the development of a resin leakage detection method based in analyzing the organic breakdown products released from resin on heating. The breakdown products are analyzed using high performance liquid chromatography (HPLC) with fluorescence detection. Some of the organic products formed have been identified. A design for a resin monitoring unit, suitable for incorporation into the IONTRAC system, is presented. Theoretically, detection of ppB levels of resin by processing about one liter of water, is possible.

39658 **(FRADOC—12-2) Framatome: an example of industrial cooperation.** Marillier, J.C. (Societe Franco-Americaine de Constructions Atomiques (FRAMATOME), 92 - Courbevoie (France)). 1986. 10p. (In French). (CONF-8611232—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88752577/JAW.

From A new approach for the customer/supplier relationship; Paris, France (18 Nov 1986).

Short note.

39659 **(FRADOC—12-3) PWR power plant reactor maintenance site experience and technology transfer.** Callot, T.R. (Societe Franco-Americaine de Constructions Atomiques (FRAMATOME), 92 - Courbevoie (France)). 1986. 10p. (CONF-8604300—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88752415/JAW.

From KAIF-KNS conference; Seoul, Korea (29 Apr 1986).

PWR reactor maintenance activities has considerably expanded during the last few years at Framatome. The services offered by Framatome can be divided into three main categories: - Implementation of backfits aimed at performance and safety improvement and equipment reliability - Technical assistance for plant operators, especially during refuelling - Maintenance and repair services during both scheduled and unscheduled outages.

39660 **(FRADOC—12-4) Technology transfer.** Boury, C. (Societe Franco-Americaine de Constructions Atomiques (FRAMATOME), 92 - Courbevoie (France)). 1986. 20p. (CONF-8609398—). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88752424/JAW.

From Energy and power plants trade fair; Rotterdam, Netherlands (9 Sep 1986).

This paper emphasizes in the specific areas of design, engineering and component production. This paper presents what Framatome has to offer in these areas and its export oriented philosophy. Then, a typical example of this technology transfer philosophy is the collaboration with the South Korean firm, Korea Heavy Industries Corporation (KHIC) for the supply of KNU 9 and KNU 10 power stations.

39661 **(FRADOC—13-1) French steam generator design developments.** Ginier, R.; Campan, J.L.; Pontier, M.; Leridon, A.; Remond, A.; Castello, G.; Holcblat, A.; Paurobally, H. (Societe Franco-Americaine de Constructions Atomiques (FRAMATOME), 92 - Courbevoie (France)). 1986. 11p. (CONF-860603—). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88752423/JAW.

From 4. European nuclear conference and 9. FORATOM congress (ENC '86) and international nuclear trade fair; Geneva, Switzerland (1 Jun 1986).

From the outset of the French nuclear power program, a significant R and D effort has been invested in improvement of the design and operation of Pressurized Water Reactors including a special committment to improving steam generators. The steam generator enhancement program has spawned a wide variety of specific R and D resources, e.g., low temperature hydraulic models for investigation of areas with single-phase flow, and freon-filled models for simulation of areas of steam generators experiencing two-phase flow (tube bundles and moisture separators). For the moisture separators, a large scale research program using freon-filled models and highly sophisticated instrumentation was used. Tests at reactor sites during startup of both 900 MWe and 1300 MWe have been used to validate the assumptions made on the basis of loop tests. These tests also demonstrated the validity of using freon to simulate two-phase flow conditions. The wealth of knowledge accumulated by the steam generator R and D program has been used to develop a new design of steam generators for the N4 plants. The current R and D effort is aimed at qualifying the N4 steam generator model and developing more comprehensive models. One prong of the R and D effort is the Megeve program. Megeve is a 25 MW steam generator which simulates operating conditions of the N4 model. The other prong is Clotaire, a freon-filled steam generator model which will be used to qualify thermal/hydraulic design codes used for multidimensional calculations for design of tube bundles.

39662 **(FRADOC—13-2) French steam generator.** Remond, A. (Societe Franco-Americaine de Constructions Atomiques (FRAMATOME), 92 - Courbevoie (France)). 1986. 27p. (In French). (CONF-8610393—). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88752412/JAW.

From Conference on the second safety barrier; Paris, France (9 Oct 1986).

After recalling the potential damage mode of tubes of steam generator, the author recalls the safety criteria used in France. The improvements and the process of damage prejudice and reparation for tubular bundle are presented.

39663 **(FRADOC—13-3) Measures introduced for improving the resistance against degradation by corrosion of steam generators in Framatome designed PWR'S.** Smith, K.; Slama, G.; Sort, M. (Societe Franco-Americaine de Constructions Atomiques (FRAMATOME), 92 - Courbevoie (France)). 1986. 8p. (CONF-860454—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88752422/JAW.

From 2. international topical meeting on nuclear power plant thermal hydraulics and operations; Tokyo, Japan (15 Apr 1986).

The operational experience of FRAMATOME plants now extends to more than 8 years with a total of 35 PWR plants commissioned and in operation for periods of time varying from 1 to 7.5 years. Overall, the 1.600 Steam Generator (S.G.) tubes are significantly free from secondary side corrosion problems. On the primary side, several instances of stress corrosion cracking have occurred, this cracking is principally at the transitions of the mechanical roll in 1.600 Mill Annealed tubing. This paper reviews the design and material changes which have been, or are being, introduced to improve the resistance to corrosion. In addition, the application is described of the FRAMATOME shot peening surface treatment to the primary side tube surface of the mechanically rolled expansions. The objective of this treatment is to increase the resistance to primary side stress corrosion cracking by appreciable reduction of the surface tensile stresses. The steam generators of several operational plants have been successfully treated by this technique.

39664 (FRADOC—13-4) Framatome recent developments and application on site in NDE of steam generator tubes. Bieth, M. (Societe Franco-Americaine de Constructions Atomiques (FRAMATOME), 92 - Courbevoie (France)). 1986. 14p. (CONF-8608215—). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88752421/JAW.

From 5. annual steam generator NDE EPRI-SGOG; Myrthe-Beach, FL, USA (12 Aug 1986).

The increasing needs concerning the follow up and expertise of PWR steam generator (SG) tubing have led Framatome to develop a quick on-site intervention mobile unit, which could implement any current technique and equipment. Besides, Framatome has developed several non destructrive examination methods to solve the specific problems encountered in service on the SG tubes: profilometry of the SG tubes by eddy current. Inside and above the tube sheet, eddy current inspection of tube sleeving by ultrasonic testing and eddy current.

39665 (FRADOC—14-1) Single rod leak detection and repair of leaking or damaged fuel assemblies. Beuneche, D. (Societe Franco-Americaine de Constructions Atomiques (FRAMATOME), 92 - Courbevoie (France)). 1986. 13p. (CONF-860452—). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88752418/JAW.

From Annual meeting on nuclear technology; Aachen, F.R. Germany (8 Apr 1986).

In some circumstances, it is necessary to perform rework operations on some fuel assemblies in order to make them reusable in reactors, movable, transportable or consistent with fuel reprocessor specifications, depending on the plant utility policy. These rework operations are of two types: - Those which consist in restoring the leak tightness of the fuel assemblies. They are made after a series of tests allowing the localization of the failed fuel rods: at first, overall leak detection is provided by monitoring primary coolant activity during reactor operation; then, during refuelling, leaking assemblies are identified by subjecting each of the assemblies scheduled for reloading to a sipping test; finally individual leaking fuel rods are singled out before the defective assemblies can be repaired, i.e. failed rods can be replaced. - Those which involve replacement of part of or the whole assembly structure (combined or not with replacement of failed fuel rods). In order to meet these two needs for rework operations, FRAGEMA has developed a full range of test and tooling systems for detecting single leaking rods in irradiated fuel assemblies and for restoring fuel assemblies to be used in PWR nuclear power plants. As an illustration of the means available, two of these systems are described.

39666 (FRADOC—14-2) Thermal transducer for level measurement. Lenclos, J.F. (Societe Franco-Americaine de Constructions Atomiques (FRAMATOME), 92 - Courbevoie (France)). 1986. 4p. (CONF-860452—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88752420/JAW.

From Annual meeting on nuclear technology; Aachen, F.R. Germany (8 Apr 1986).

Certain level measurement applications in nuclear power plants require sensors which show good reliability and satisfactory accuracy under accident conditions, and whose electronics can be located remote from the sensor (e.g. outside of reactor containment). Reliability requirements exclude the use of mechanical detectors with moving parts. Diffential pressure sensors are not accurate in accident environments, and capacitive units require that detector electronics be close-coupled to the sensor. For these reasons, solid-state thermal detectors, using proven materials and technology, have been selected for severe nuclear plant applications. The electronics associated with the detector is located remote from the sensor, and digital signal processing is feasible. The system described in this paper was developed in collaboration with the Commissariat a l'Energie Atomique (CEA).

39667 (FRADOC—14-4) Framatome's "SAF" engineering simulator: a first step toward defining the engineer's simulation tool of the year 2000. Constantieux, T. (Societe Franco-Americaine de Constructions Atomiques (FRAMATOME), 92 - Courbevoie (France)). 1986. 9p. (CONF-8609398—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88752441/JAW.

From Energy and power plants trade fair; Rotterdam, Netherlands (9 Sep 1986).

Among the techniques available to engineers today, computerized simulation is taking on an ever-growing importance. The "SAF" simulator, designed by Framatome for the use of its own engineers, has been in service since 1985. The SAF simulator provides continuous assistance to the engineer, from the preliminary design stage to the precise definition of operating procedures, including safety analysis and sizing computations. For the engineer of the year 2000, who will be used to dialoguing with the computer from a very young age, the SAF represents a first step toward a comprehensive simulation tool. Interactive and thus "alive", the SAF combines both extensive programming and data processing capabilities. Its simulation domain can still be considerably extended. Highly modular and equipped with easy-to-use compilers, the SAF can be readily modified and reconfigured by the user, to enable testing new models or new systems, in the complex and detailed environment of the nuclear unit being analysed. Employing the advanced computer programs used in project design, the SAF simulator is a particularly high-performance tool for simulating and analysing complex accident scenarios, including multiple equipment failures and possible operator errors, which may extend to complete draining of the reactor vessel and the release of radioactive fission products within the containment structure.

39668 (FRADOC—15-5) TS 600: automatic control system for eddy currents. Poulet, J.P. (Societe Franco-Americaine de Constructions Atomiques (FRAMATOME), 92 - Courbevoie (France)). Oct 1986. 7p. (In French). (CONF-8609218—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88752413/JAW.

From 6. international conference on non destructive testing methods; Biarritz, France (30 Sep 1986).

In the scope of fabrication and in service inspection of the PWR steam generator tubing bendle, FRAMATOME developed an automatic Eddy Current testing system: TS600. Based on a minicomputer, TS600 allows to digitize, to store and to process data in various ways, so it is possible to perform several kinds of inspection: conventional inservice inspection, roll area profilometry..... TS600 can also be used to develop new methods of examination.

39669 (INIS-BR—1118) Design of nuclear power plants. Lobo, C.G. (NUCLEN, Rio de Janeiro (Brazil)). 1987. 55p. (In Portuguese). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88703219/JAW.

The criteria of design and safety, applied internationally to systems and components of PWR type reactors, are described. The main criteria of the design analysed are: thermohydraulic optimization; optimized arrangement of buildings and components; low costs of energy generation; high level of standardization; application of specific safety criteria for nuclear power plants. The safety criteria aim to: assure the safe reactor shutdown; remove the residual heat and; avoid the release of radioactive elements for environment. Some exemples of safety criteria are given for Angra-2 and Angra-3 reactors. (M.C.K.).

39670 (INIS-BR—1137) Organization and management of design. Danelli, I.G. (PROMON Engenharia S.A., Rio de Janeiro (Brazil)). 1987. 37p. (In Portuguese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703237/JAW.

The steps for implementation of designs, the organization and the management of PROMON are presented. The Design of Angra-1 reactor and the Design of Angra-2 Pipes, are presented as examples. (M.C.K.).

39671 (INIS-mf—11220) Metrology provision of nuclear power plants linked up to metrology provision of the fuel and power engineering department. Chajkin, I. (Ceskoslovenska Vedeckotechnicka Spolecnost, Prague. Dum Techniky). 1986. 9p. (In Czech). (CONF-8606407—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88703052/JAW.

From 12. national seminar on measurements in power engineering; Zdar nad Sazavou, Czechoslovakia (9 Jun 1986).

Published in seminar proceedings "Metrologie jadernych elektraren", p. 5-13.

Metrology aspects are discussed with respect to metrology in the fuel and power department. For this branch, CSN 40 3610 has been in force since 1 January 1986 which specifies what the project design documents must contain with respect to metrology. The specifications of the standard will already be met by the project design documents for the Temelin nuclear power plant. The organization for metrology within CMEA is economic association Interatomehnergo which produces technical normatives for nuclear power plant metrology. A table is presented showing the ranges of quantities and the required measurement accuracy in nuclear power plants for pressure, temperatures, vibrations, electrical quantities, physico-chemical quantities, and ionizing radiation. (Z.M.). 5 refs., 1 tab.

39672 **(INIS-mf—11244) Temperature and pressure metrology in nuclear power plants.** Konicek, P.; Sabata, J. (Ceskoslovenska Vedeckotechnicka Spolecnost, Prague. Dum Techniky). 1986. 5p. (In Czech). (CONF-8606407—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88703058/JAW.

From 12. national seminar on measurements in power engineering; Zdar nad Sazavou, Czechoslovakia (9 Jun 1986).

Published in seminar proceedings "Metrologie jadernych elektraren", p. 65-69.

The problems are discussed relating to the measurement of temperature and pressure in nuclear power plants, with regard to WWER-440 reactors. Attention is mainly centred on in-core measurement where the measured values mainly serve the assessment of the immediate state of the reactor core, the distribution of temperatures of fuel elements, the possible damage of fuel element cladding or such failures as is the local loss of coolant flow. Questions are discussed of the required accuracy of measurement with regard to temperature, pressure, the number and range of sensors and their in-service testing. (Z.M.).

39673 **(INIS-mf—11245) Metrology of electric variables at the Dukovany nuclear power plant.** Rygl, Z. (Ceskoslovenska Vedeckotechnicka Spolecnost, Prague. Dum Techniky). 1986. 6p. (In Czech). (CONF-8606407—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88703059/JAW.

From 12. national seminar on measurements in power engineering; Zdar nad Sazavou, Czechoslovakia (9 Jun 1986).

Published in seminar proceedings "Metrologie jadernych elektraren", p. 80-85.

The problems are discussed of the metrology of electric variables at the Dukovany nuclear power plant. From the requirements of nuclear safety and operating reliability follows the need of multiple and redundant functional elements and elements of measuring chains. This represents a great number of sensors of a wide range of diverse physical quantities whose outputs are converted to any of the electric quantities. The respective elements of measuring chains mostly have the character of in-service meters. The diagram is presented of the metrological continuity of measuring instruments for electric quantities at the Dukovany nuclear power plant. Briefly described are procedures of testing various types of measuring instruments. (Z.M.). 2 figs.

39674 **(INIS-mf—11246) Metrology provision of the Bohunice nuclear power plant.** Opatovsky, L. (Ceskoslovenska Vedeckotechnicka Spolecnost, Prague. Dum Techniky). 1986. 4p. (In Czech). (CONF-8606407—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88703060/JAW.

From 12. national seminar on measurements in power engineering; Zdar nad Sazavou, Czechoslovakia (9 Jun 1986).

Published in seminar proceedings "Metrologie jadernych elektraren", p. 86-89.

The metrology of nuclear power plants in Jaslovske Bohunice is taking place at two levels. Activities connected with the testing of control instruments and operating standards, metrological surveillance and the official testing of measuring instruments are provided by the enterprise metrological centre. Activities connected with the metrological control of in-service meters take place in special laboratories. Metrological inspection in the enterprise metrological centre includes the following measurement fields: temperature, pressure, electric variables, force and moment of force, length. The instrumentation used by the centre is described. A department is being built for the maintenance of the system of reactor protection and control and calibration equipment is being provided for dosimetric purposes. The inventory of standard meters, metrological inspections and their planning is processed on an EC 1055 computer. (Z.M.).

39675 **(INIS-mf—11247) Specificity of metrology control of operational meters at the Bohunice nuclear power plant.** Cambal, E. (Ceskoslovenska Vedeckotechnicka Spolecnost, Prague. Dum Techniky). 1986. 4p. (In Slovak). (CONF-8606407—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88703061/JAW.

From 12. national seminar on measurements in power engineering; Zdar nad Sazavou, Czechoslovakia (9 Jun 1986).

Published in seminar proceedings "Metrologie jadernych elektraren", p. 90-93.

The specific problems are discussed of metrological testing of in-service measuring instruments at the Jaslovske Bohunice nuclear power plant. Care of these instruments takes place in three stages. The departments of basic operations are responsible for the first stage, i.e., they are responsible for instruments on the assembly site. The second stage, i.e., repairs and testing in special workshops is the responsibility of the department for repairing measuring and control instruments. In order to be able to quickly remove failures of instruments, namely those which affect power generation, it is routine practice to replace defective instruments and to repair them later in the workshops. Some 50% of all repairs at the V-2 nuclear power plant are implemented in this way, at the V-1 plant 30%. It is stated that shortcomings in the equipment of the workshops are being removed and the necessary measures to be taken to improve the situation are outlined. (Z.M.).

39676 **(INIS-mf—11248) Technological process of metrological inspection of measuring and control chains at the Bohunice nuclear power plant.** Kerak, J. (Ceskoslovenska Vedeckotechnicka Spolecnost, Prague. Dum Techniky). 1986. 8p. (In Slovak). (CONF-8606407—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88703062/JAW.

From 12. national seminar on measurements in power engineering; Zdar nad Sazavou, Czechoslovakia (9 Jun 1986).

Published in seminar proceedings "Metrologie jadernych elektraren", p. 94-101.

Special demands are placed on the metrological inspection of measuring and control chains in nuclear power plants, namely because most of the elements of these chains are not accessible during reactor operation, they have to be protected against contamination, measurement precision must be much higher than in conventional power plants and all measuring and control instruments must show high reliability and safety. The number of measuring and control chains is high: at the V-1 nuclear power plant in Jaslovske Bohunice there are about 7000 and at the V-2 power plant more than 10,000. A detailed description is presented of the system of preventive care of these chains in the nuclear power plants at Jaslovske Bohunice. The records and planning of preventive care are computer processed. Also discussed are certain problems and shortcomings of the present metrology of measuring and control chains at the said nuclear power plants. (Z.M.).

39677 **(INIS-mf—11740) Radiation embrittlement of reactor pressure vessel - BMFT/USNRC cooperation. Final report.** Foehl, J.; Gross, K.J. (Staatliche Materialpruefungsanstalt, Stuttgart (Germany, F.R.)). Oct 1986. 48p. (In German). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88753816/JAW.

On the basis of comparison materials irradiated in different reactors the integrated effect of all factors accounted for the embrittlement-recovery equilibrium including test and evaluation procedures is to be investigated. A test melt with low upper shelf energy (low shelf test melt LSTM) on the basis of 22 NiMoCr 3 7 (KS 07 A/B) with a chemical composition exceeding the specified limits was selected for this purpose. Together with specimens of material 22NiMoCr 3 7 and 20 MnMoNi 5 5 according to present specification for reactor pressure vessels of light water reactors, the

irradiation behavior of the KS 07 material is being investigated in the United States of America in comparison to the research program 'Integrity of components (FKS)' conducted in Germany. This report presents the results from tensile, Charpy impact and fracture mechanics tests obtained within the HSST (heavy section steel technology program) program. First results from the FKS program are given for comparison. A complete evaluation can only be made within the final FKS report 'Irradiation' since at this time not all the necessary results are available. (orig./IHOE)

39678 **(JAERI-M—87-213) Development of plant dynamic analysis code for integrated self-pressurized water reactor (ISPDYN), and comparative study of pressure control methods.** Kusunoki, Tsuyoshi; Yokomura, Takeyoshi; Nabeshima, Kunihiko; Shimazaki, Junya; Shinohara, Yoshikuni. (Japan Atomic Energy Research Inst., Tokyo). Jan 1988. 110p. (In Japanese). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88753619/JAW.

This report describes the development of plant dynamic analysis code (ISPDYN) for integrated self-pressurized water reactor, and comparative study of pressure control methods with this code. ISPDYN is developed for integrated self-pressurized water reactor, one of the trial design by JAERI. In the transient responses, the calculated results by ISPDYN are in good agreement with the DRUCK calculations. In addition, this report presents some sensitivity studies for selected cases. Computing time of this code is very short so as about one fifth of real time. The comparative study of self-pressurized system with forced-pressurized system by this code, for rapid load decrease and increase cases, has provided useful informations.

39679 **(KFK—4343) Experiments on ballooning in pressurized and transiently heated Zircaloy-4 tubes.** Markiewicz, M.E.; Erbacher, F.J. (Comision Nacional de Energia Atomica, Buenos Aires (Argentina). Centro Atomico Constituyentes). (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Material- und Festkoerperforschung; Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Reaktorbauelemente; Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Projektgruppe LWR-Sicherheit). Feb 1988. 45p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88754026/JAW.

Single-rod burst tests were performed with Atucha I Zircaloy-4 cladding tubes in the REBEKA burst equipment of KfK. The objective was to investigate the ballooning and burst behavior of argentine cladding tubes obtained from NRG, Germany and CONVAR, Argentina. The burst data were compared with those of cladding tubes used in german PWR's. It was found that the burst data e.g. burst temperature, circumferential burst strain and its response to azimuthal temperature differences are identical for the Argentine and German tubing quality. The burst data are in good agreement with those of German PWR-Zircaloy tubes. Thus, the fuel rod behavior codes developed for German PWR's can also be used for the Argentine reactor Atucha I.

39680 **(KFKI—1987-69/G,M) Fuel behaviour.** Fodor, M.; Matus, L.; Vigassy, J. (Hungarian Academy of Sciences, Budapest. Central Research Inst. for Physics). Nov 1987. 25p. (In Hungarian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703426/JAW.

A short summary of the main critical points in fuel performance of nuclear power reactors from chemical and mechanical point of view is given. A schedule for a limited research program is included. (author) 17 refs.

39681 **(KFKI—1987-72/G) Calculations for the prediction of accident situation. Analysis of the loss of feedwater transient.** Perneczky, L.; Szabados, L.; Toth, I. (Hungarian Academy of Sciences, Budapest. Central Research Inst. for Physics). Nov 1987. 51p. (In Hungarian). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88703428/JAW.

The report deals with the analysis of the loss of feedwater transient assuming that the pressurizer safety valve remains open throughout the process. The scenario is the Paks NPP counterpart of the loss of feedwater test performed on the PMK-NVH facility. The initial and boundary conditions of the calculation agree with those of the experiment allowing direct comparison with experimental results. (author) 18 refs.; 34 figs.

39682 **(NUREG/CR—4597-Vol.2) Aging and service wear of auxiliary feedwater pumps for PWR nuclear plants: Volume 2, Aging assessments and monitoring method evaluations.** Kitch, D.M.; Schlonski, J.S.; Sowatskey, P.J.; Cesarski, W.V. (Oak Ridge National Lab., TN (USA); Westinghouse Electric Corp., Pittsburgh, PA (USA). Generation Technology Div.). Jun 1988. Contract AC05-84OR21400. 127p. (ORNL—6282-V.2). NTIS, PC A07/MF A01 - GPO. Order Number TI88012499/JAW.

This report was produced under the Detection of Defects and Degradation Monitoring Element of the Nuclear Plant Aging Research Program. It addresses aging assessments and monitoring method evaluations for auxiliary feedwater pumps (AUXFPs). The report contains four major sections: failure causes; review of inspection, surveillance, and condition monitoring (ISCM) methods; evaluation of ISCM methods; and role of maintenance in alleviating aging and service wear. Failure causes attributable to aging and service wear are given and ranked in terms of importance. Cause identifications are made on the bases of experience, postservice examinations, and in situ assessments. Measurable parameters related to failure causes are identified. ISCM methods are also identified, evaluations are made based on Westinghouse (W) experience, and recommendations are given. The methods are intended to yield required capabilities for establishing operational readiness, as well as for detecting and tracking degradation. The role of maintenance in mitigating aging and service wear effects is discussed, and the relationship of maintenance to ISCM methods is identified. Predictive, preventive, and corrective maintenance practices are discussed and evaluated.

39683 **(UCID—21438) Structural evaluation of the Shippingport Reactor Pressure Vessel and Neutron Shield Tank package for impact and puncture loads.** Fischer, L.E.; Chou, C.K.; Lo, T.; Schwartz, M.W. (USDOE Richland Operations Office, WA; Lawrence Livermore National Lab., CA (USA)). Jun 1988. Contract W-7405-ENG-48. 116p. NTIS, PC A05;3. Order Number DE88012452/JAW.

A structural evaluation of Shippingport Reactor Pressure Vessel and Neutron Shield Tank package for impact and puncture loads under the normal and hypothetical accident conditions of 10 CFR 71 was performed. Component performance criteria for the Shippingport package and the corresponding structural acceptance criteria for these components were developed based on a review of the package geometry, the planned transport environment, and the external radiation standards and dispersal limits of 10 CFR 71. The evaluation was performed using structural analysis methods. A demonstration combining simplified model tests and nonlinear finite element analyses was made to substantiate the structural analysis methods used to evaluate the Shippingport package. The package was analyzed and the results indicate that the package meets external radiation standards and release limits of 10 CFR 71. 13 refs., 50 figs., 19 tabs.

39684 **Analysis of thermal tests in a pressurized water reactor having asymmetric loop flows.** Lyczkowski, R.W.; Kim, J.H.; Fohs, H.P.; Domanus, H.M. (Argonne National Lab., 9700 South Cass Avenue, Argonne, IL (US)). *Nuclear Science and Engineering;* **98**: No. 3, 183-208(Mar 1988).

An analysis was made of three-dimensional steady-state computations from the thermal mixing tests performed in the Oconee 1 pressurized water reactor at the beginning of fuel cycle 6 early in 1980 under the sponsorship of the Electric Power Research Institute. It was found that detailed modeling of the 52 asymmetrically located instrument guide tubes, together with the various structures in the lower plenum, yielded generally good agreement with the data (within 1°F). Most of the thermal mixing trends at the entrance to the core and midplane deduced from the 29-thermocouple reading were correctly computed.

39685 Evaluation of cracks in basemat of an operating plant. Miller, C.A.; Kuo, P.T.; Reich, M. (City Univ. of New York, NY (USA);Nuclear Regulatory Commission, Washington, DC (USA);Brookhaven National Lab., Upton, NY (USA)). pp 287-291 of Transactions of the 9th international conference on structural mechanics in reactor technology. Vol. D. Experience with structures and components in operating reactors. Wittmann, F.H. (ed.). Rotterdam, Netherlands; Balkema (1987). (CONF-870812—).

From 9. SMIRT: international conference on structural mechanics in reactor technology; Lausanne, Switzerland (17 Aug 1987).

All of the structures of the Waterford nuclear power plant are founded on a twelve feet thick basemat having plan dimensions of about 250 feet by 350 feet. The top of the mat is about fifty feet below the ground surface. This paper describes some work that was done to evaluate the extent to which the cracks may effect the basemat's performance under service and seismic loadings. As indicated above the constuction sequence loading led to a convex-up deformation of the mat so that the top of the mat was in tension. The top reinforcement in the mat is relatively light (temperature steel) so that any flexural cracks originating at the top of the mat would be expected to propagate deeply into the mat. All of the operating loads (including seismic) result in bending moments which produce compressive stresses at the top of the mat. It is reasonable to expect that any crack which existed in the top of the mat would have little effect on the performance of the mat when it was subjected to bending moments which produce compressive stresses in the precracked region. A question was raised, however, as to whether these cracks might have some effect on the ability of the mat to sustain seismic over loads. A series of static tests were performed to evaluate the effect of precracks on the near-ultimate load behavior of beams having flexural properties similar to those of the Waterford mat. The test program and results are discussed in this paper.

39686 Performance of Diablo Canyon annulus steel structure. Miller, C.A.; Philippacopoulos, A.J.; Kuo, P.T. (City Univ. of New York, NY (USA);Brookhaven National Lab., Upton, NY (USA);Nuclear Regulatory Commission, Washington, DC (USA)). pp 423-427 of Transactions of the 9th international conference on structural mechanics in reactor technology. Vol. D. Experience with structures and components in operating reactors. Wittmann, F.H. (ed.). Rotterdam, Netherlands; Balkema (1987). (CONF-870812—).

From 9. SMIRT: international conference on structural mechanics in reactor technology; Lausanne, Switzerland (17 Aug 1987).

This paper describes portions of the review effort that were undertaken to license the Diablo Canyon nuclear power plant. A rather extensive process was undertaken because of the severe seismic environment and because several errors were uncovered which cast doubt on the adequacy of the quality assurance program that was implemented by the designers during the seismic analysis of the plant. An IDVP was established which reviewed a large portion of the safety related seismic analyses. The function of this review was to identify specific errors in design and to determine whether these errors had generic implications for other portions of the design. The principal sources of errors which were found resulted from poor communication across design interfaces. Sufficient controls had not been established to insure that the latest design data was available as needed. The NRC performed independent analyses of the vertical and horizontal seismic response of the annulus steel structure. Complete three dimensional models of the structure were used for these analyses. A comparison of the floor response spectra generated from these models with the simpler models used by the utility showed significant differences. The differences generally were found to result from the ommision of structural flexibilities in the models used by the utility. Special care must be taken when using simple structural models to insure that all important modes of response are included.

39687 Investigation of failed type 410 stainless steel shafts from main steam isolation valves at two operating plants. Czajkowski, C.J. Houston, TX; National Assoc. of Corrosion Engineers (1987). 11p. (CONF-870314—). National Assoc. of Corrosion Engineers, P.O. Box 218340, Houston, TX 77218.

From Corrosion '87; San Francisco, CA, USA (9 Mar 1987).

Metallurgical investigations were performed on a cracked main steam isolation valve (MSIV) shaft from the Joseph M. Farley Unit #1 station and two MSIV shafts from the R.E. Ginna Station (only one shaft cracked). This investigation consisted of optical microscopy, chemical analysis, hardness testing, scanning electron microscopy and energy dispersion spectroscopy. The shafts were manufactured from ASTM A276, Type 410 stainless steel in the quenched and tempered condition. The crack on the Farley shaft ran longitudinally and was approximately 16.7 cm (6.6 inches) in length. The crack on the Ginna shaft was approximately 7.6 cm (3 inches) in length and ran almost pendicularly to the shaft's long axis. The second Ginna shaft had not visible cracks. Hardness measurements of the shafts revealed that the Farley shaft hardness values ranged between R/sub c/ 41-44.5, the cracked Ginna shaft values ranged between R/sub c/ 42.9-45, while the uncracked shaft's hardness was R/sub c/ 36-44.6. The cracks were intergranular and occurred on prior austenite grain boundaries. No evidence of corrosive species or fatigue contribution was seen. This cracking is considered to be an intergranular stress corrosion cracking phenomenon resulting from a high hardness/susceptible material in a pressurized water environment.

39688 Single and two-phase natural circulation in Westinghouse pressurized water reactor simulators: Phenomena, analysis and scaling. Schulz, R.R.; Chapman, J.C.; Kukita, Y.; Motley, F.E.; Stumpf, H.; Chen, Y.S.; Tasaka, K. (Idaho National Engineering Lab. (INEL), Reactor Thermal Hydraulic Research Program, Idaho Falls, ID (US)). pp 59-70 of Natural circulation. Kim, J.H.; Hassan, Y.A. New York, NY; American Society of Mechanical Engineers (1987). (CONF-871234—).

From ASME winter meeting; Boston, MA, USA (13 Dec 1987).

Natural circulation data obtained in the 1/48 scale W four loop PWR simulator - the Large Scale Test Facility (LSTF) are discussed and summarized. Core cooling modes, the primary fluid state, the primary loop mass flow and localized natural circulation phenomena occurring in the steam generator are presented. TRAC-PF1 LSTF model (using both a 1 U-tube and a 3 U-tube steam generator model) analyses of the LSTF natural circulation data including the SF recirculation patterns are presented and compared to the data. The LSTF data are then compared to similar natural circulation data obtained in the Primarkreislaufe (PKL) and the Semiscale facilities. Based on the 1/48 to 1/1705 scaling range which exists between the facilities, the implications of these data toward natural circulation behavior in commercial plants are briefly discussed.

39689 Natural circulation cooling during a small-break loss-of-coolant accident in a simulated pressurized water reactor. Loomis, G.G.; Larson, T.K.; Streit, J.E. (Idaho National Engineering Lab., EG and G Idaho, Inc., Idaho Falls, ID (US)). pp 71-82 of Natural circulation. Kim, J.H.; Hassan, Y.A. New York, NY; American Society of Mechanical Engineers (1987). (CONF-871234—).

From ASME winter meeting; Boston, MA, USA (13 Dec 1987).

This paper presents experimental results from a simulated small-break loss-of-coolant accident (SBLOCA) involving natural circulation core heat rejection mechanisms. The experimental results are compared to pre-experiment RELAP5/MOD2 calculations, and finally are related to expected pressurized water reactor (PWR) behavior during SBLOCA conditions. The simulation conducted in the Semiscale MOD-2C scaled-experiment facility was a 0.5% cold leg centerline break performed at high temperature and pressure with initial conditions typical of a PWR (15.6-MPa pressure, 587-K hot leg fluid temperature). The Semiscale MOD-2C facility represents all major components of a large PWR. The facility includes active loops, steam generators, and a vessel with an electrically heated core. The transition from forced circulation to the var-

ious modes of natural circulation was characterized in the Semiscale simulation. The natural circulation cooling modes observed include single-phase, two-phase, and reflux. Analysis included extensive decoupling of natural circulation heat rejection modes between the loops, and multi-dimensional effects within the steam generator U-tubes. Comparison of RELAP5/MOD2 calculations with data shows correct qualitative calculation of the occurrence of single-phase two-phase, and reflux cooling during the Semiscale transient. Analysis of similitude criteria for the Semiscale facility suggests that the Semiscale results preserve the first order effects though important for natural circulation phenomena expected in a PWR.

39690 **Reverse primary-side flow in steam generators during natural circulation cooling.** Stumpf, H.; Motley, F.; Schultz, R.; Chapman, J.; Kukita, Y. (Reactor Safety Code Development Group, Nuclear Technology and Engineering Div., Los Alamos National Lab., Los Alamos, NM (US)). pp 103-110 of Natural circulation. Kim, J.H.; Hassan, Y.A. New York, NY; American Society of Mechanical Engineers (1987). (CONF-871234—).

From ASME winter meeting; Boston, MA, USA (13 Dec 1987).

A TRAC model of the Large Scale Test Facility with a 3-tube steam-generator model was used to analyze natural-circulation test ST-NC-02. For the steady state at 100% primary mass inventory. TRAC was in excellent agreement with the natural-circulation flow rate, the temperature distribution in the steam-generator tubes, and the temperature drop from the hot leg to the steam-generator inlet plenum. TRAC also predicted reverse flow in the long tubes. At reduced primary mass inventories, TRAC predicted the three natural-circulation flow regimes: single phase, two phase, and reflux condensation. TRAC did not predict the cyclic fill-and-dump phenomenon seen briefly in the test. TRAC overpredicted the two-phase natural-circulation flow rate. Since the core is well cooled at this time, the result is conservative. An important result of the analysis is that TRAC was able to predict the core dryout and heatup at approximately the same primary mass inventory as in the test.

2103 Power Reactors, Non-breeding, Graphite Moderated

REFER ALSO TO CITATION(S) 39063, 39754, 39796, 39821, 39833, 39835, 39836, 39962, 40035

39691 **(INIS-BR—962) Candu system - The way for nuclear autonomy.** Martinez, H. (American Nuclear Society, Rio de Janeiro (Brazil). Latin American Section). 1987. 7p. (In Spanish). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88701616/JAW.

The experience acquired by Canada during the development of Candu System is presented. Some basic foundations of technology transfer are defined and, the conditions of canadian nuclear industry to provide developing countries, technical assistence for acquisition of nuclear energy autonomy, are analysed. (M.C.K.).

39692 **(JAERI-M—88-032) Three-dimensional thermal analysis code for in-core test section (T/sub 2/) of HENDEL, SSPHEAT.** Ioka, Ikuo; Inagaki, Yoshiyuki; Kunitomi, Kazuhiko; Suzuki, Kunihiko; Miyamoto, Yoshiaki; Aizawa, Ryouji. (Japan Atomic Energy Research Inst., Tokyo). Feb 1988. 97p. (In Japanese). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88754117/JAW.

A three-dimensional analysis code "SSPHEAT" has been developed to analyze minutely the temperature distribution in the in-core structure test section (T/sub 2/) of HENDEL with complicated passeges of helium flow. The helium flow is simulated by a thermal-flow element, which is a uniaxial element in three-dimensional space with the ability to conduct heat and transmit fluid between its nodal points. The element has two parameters, temperature and pressure, at each nodal point. In the computer code, the model is solved by the finite element method (FEM). This report discribes an analytical model of T/sub 2/ test section, a numerical method, an outline of program and a couple of calculated results. The conditions of calculation are steady state (hot helium gas: 900 deg C, 4 kg/s and cold helium gas: 400 deg C, 4 kg/s) and unsteady state (decrease of hot helium gas temperature from 900 deg C to 700 deg C at 50 deg C/hr).

39693 **(JAERI-M—88-070) Study on flow-induced vibration of the fuel rod in HTTR.** Takase, Kazuyuki. (Japan Atomic Energy Research Inst., Tokyo). Mar 1988. 57p. (In Japanese). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88754131/JAW.

This study was performed in order to investigate flow-induced vibration characteristics of a fuel rod in HTTR (High Temperature engineering Test Reactor) from both an experiment and a numerical simulation. Two kinds of fuel rods were used in this experiment: one was a graphite rod which simulated a specification of the HTTR's fuel rod and the other was an aluminum rod whose weight was a half of the graphite one. The experiment was carried out up to Re = 31000 using air at room temperature and pressure. Air flowed downstream in an annular passage which consisted of the fuel rod and the graphite channel. Numerical simulations by fluid and frequency equations were also carried out. Numerical and experimental results were then compared. The following conclusions were drived: (1) The fuel rod amplitudes increase with the flow rate and with a decrease of the fuel rod weight. (2) The fuel rod amplitudes are obtained by $\delta/De = 2.22 \times 10/sup -10/Re/sup 1.43/$, $9000 \leqq Re \leqq 31000$, where δ is a vibration amplitude, De is a hydraulic diameter and Reis Reynolds number. (3) The fuel rod frequencies shift from lower natural frequency to higher as the flow rate increases. (4) The flow-induced vibration behavior of the fuel rod can simulate well by simultaneous equations which used the turbulence model for fluid and the mass model for vibration of the fuel rod.

39694 **(JAERI-M—88-072) Flow visualization around an obstacle by oil film method.** Takase, Kazuyuki. (Japan Atomic Energy Research Inst., Tokyo). Mar 1988. 75p. (In Japanese). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88753644/JAW.

Flow patterns around an obstacle settled between walls in a parallel channel were investigated by oil film method which was one of the flow visualization procedures. In the oil film method, visual flow patterns are drawn with a film spread on a body surface. The oil film used in this experiment was a mixture which was composed of silicon oil, pigment and Oleic acid. The composition of the mixture was adjusted until flow patterns could observe at the most clear conditions for each flow velocity. The application range of this method was extended to lower velocity of air flow than the usual value since the composition of the oil film was improved. Six types of obstacles in configuration were chosen for the experiment: one was a vertical cylinder and the others were five kinds of objects simulated spacer-ribs on fuel rod surface in HTTR. Observations were performed to reveal appearances of flow patterns around various obstacles such as a counter flow region in front of the obstacle, a horseshoe vortex around it and a wake flow region in the rear of it. Numerical calculations were also carried out for flow around the obstacle. The experimental results found to be good agreement with those of numerical calculations.

39695 **(Juel—2167) Two-dimensional reactor dynamic program TINTE. Pt. 1. Basic assumptions and solution procedure.** Gerwin, H. (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Reaktorentwicklung). Nov 1987. 110p. (In German). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88753827/JAW.

The TINTE code deals with the nuclear and the thermal transient behaviour of an HTR taking into consideration the mutual feedback effects in two-dimensional r-z-geometry. Initial equations, approximations and solution procedures are compiled in this first part of the description. This involves the following subproblems: Time-dependent neutron flux calculation. Time-dependent heat source distribution (local and non-local fractions). Time-dependent heat transport from the fuel to the fuel element surface. Time-dependent global temperature distribution. Glas-flow even under natural circulation conditions for both a given total mass flow and a given pressure difference. Convection and its feedback to the circulation. The iterations of subproblem solutions, necessary because of

the separate treatment, are discussed for both the transient case and of the determination of the steady initial state. (orig.)

39696 **(NUREG—1226) Development and utilization of the NRC policy statement on the regulation of advanced nuclear power plants.** Williams, P.M.; King, T.L. (Nuclear Regulatory Commission, Washington, DC (USA). Div. of Regulatory Applications). Jun 1988. 65p. NTIS, PC A04/MF A01 - GPO. Order Number TI88012641/JAW.

On March 26, 1985, the US Nuclear Regulatory Commission issued for public comment a "Proposed Policy for Regulation of Advanced Nuclear Power Plants" (50 FR 11884). This report presents and discusses the Commission's final version of that policy as titled and published on July 8, 1986 "Regulation of Advanced Nuclear Power Plants, Statement of Policy" (51 FR 24643). It provides an overview of comments received from the public, of the significant changes from the proposed Policy Statement to the final Policy Statement, and of the Commission's response to six questions contained in the proposed Policy Statement. The report also discusses the definition for advanced reactors, the establishment of an Advanced Reactors Group, the staff review approach and information needs, and the utilization of the Policy Statement in relation to other NRC programs, including the policies for safety goals, severe accidents and standardization. In addition, guidance for advanced reactors with respect to operating experience, technology development, foreign information and data, and prototype testing is provided. Finally, a discussion on the use of less prescriptive and nonprescriptive design criteria for advanced reactors, which the Policy Statement encourages, is presented.

39697 **(WHC-SA—0159-FP) Departure from nucleate boiling in annular flow channels calculated by the Weisman physically-based DNB (departure from nucleate boiling) correlation.** Wittekind, W.D. (Westinghouse Hanford Co., Richland, WA (USA)). Dec 1987. Contract AC06-87RL10930. 22p. (CONF-880724—18). NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88009196/JAW.

From 25. American Society of Mechanical Engineers/American Institute of Chemical Engineers/American Nuclear Society national heat transfer conference; Houston, TX, USA (24 Jul 1988).

Departure from nucleate boiling (DNB) correlations have historically been empirical relationships used to interpolate and smooth measured data. The correlations generally used a number of fitted parameters and had limited reliability for extrapolation. In this paper, a phenomenological DNB correlation for the forced convection, subcooled, and low-quality region is used to correlate subchannel DNB measurements for tube and annuli to improve the understanding of the trends in the DNB phenomena and to reduce the effect of individual outlying measurements. Other advantages of the phenomenological method, besides reducing the number of fitted parameters to one, were to reduce the standard deviation of measured data about the DNB correlation prediction and to have a basis for filling in gaps in the previously measured data. By this approach, the DNB correlation has served to improve the implementation of DNB measurements for their intended purpose.

39698 **Thermal analysis of lithium cooled natural circulation loop module for fuel rod testing in the fast flux test facility.** Eyler, L.L.; Kim, D.; Stover, R.L.; Beaver, T.R. (Battelle, Pacific Northwest Lab., Richland, WA (US)). pp 265-272 of Natural circulation. Kim, J.H.; Hassan, Y.A. New York, NY; American Society of Mechanical Engineers (1987). (CONF-871234—).

From ASME winter meeting; Boston, MA, USA (13 Dec 1987).

Maximum heat removal capability of a design concept for a lithium cooled natural circulation fuel rod test module is determined. Module geometry is optimized within limitations of design specifications for nominal operation temperatures, materials and test module environment. Results provide test module operation limits and range of potential uncertainties.

39699 **Air natural circulation decay heat removal for small gas-cooled reactors.** Hills, R.P. (Bechtel National, Inc., San Francisco, CA (US)). pp 281-290 of Natural circulation. Kim, J.H.; Hassan, Y.A. New York, NY; American Society of Mechanical Engineers (1987). (CONF-871234—).

From ASME winter meeting; Boston, MA, USA (13 Dec 1987).

Several small high temperature gas-cooled reactor (HTGR) concepts are being developed which have a number of inherent safety features in common. A key feature of these designs is the capability of the reactor to reject decay heat passively by conduction, convection and radiation from the core to the reactor compartment via an uninsulated vessel. The system described herein removes the decay heat from the reactor compartment to the environs by the natural circulation of outside air through cooling panels surrounding the reactor vessel. The design and performance of the system are discussed.

2104 Power Reactors, Non-breeding, Otherwise Moderated Or Unmoderated

REFER ALSO TO CITATION(S) 39679, 39728, 39791, 39796, 39938

39700 **(AECL—9001) Apparatus for study of transient oxidation of Zircaloy-4 tubing.** Sagat, S.; Iglesias, F.C.; Newell, G.W. (Atomic Energy of Canada Ltd., Chalk River, Ontario. Chalk River Nuclear Labs.). Nov 1985. 13p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703086/JAW.

Complex transient oxidation tests on Zircaloy-4 tubing were performed to provide data for validation of the computer code FROM2. This code was developed to calculate oxygen distribution through oxidized Zircaloy tubing. The test temperature histories consisted of ramp, hold and cool cycles. The heating and cooling rates were in the range of 1 to 100 K/s and the maximum temperature was 1875 K. The apparatus developed to perform these experiments is described. In principle, Joule heating is used to heat the specimen and the temperature is controlled by a computer in conjunction with temperature and SCR power controllers. Using this combination, fast heating and cooling rates were achieved without sacrificing the accuracy of temperature control.

39701 **(INIS-mf—11276) Executive brief to federal government 'the Canadian nuclear industry - a national asset'.** (Canadian Nuclear Association, Toronto, Ontario). Mar 1985. 3p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88703277/JAW.

Prepared in response to the Federal Finance Minister's 'A new direction for Canada'.

Over a period of 40 years Canada has developed a remarkable nuclear industry. In keeping with our mining heritage, we are the world's leading uranium producer, with the highest grade orebodies in existence still waiting to be tapped. In the realm of high technology development, our CANDU reactor is second to none. Year after year Canadian CANDUs dominate the 'top 10' performance records world-wide. The nuclear industry has created direct employment for over 30,000 Canadians. The 'high tech' sectors of the industry are now vigorously seeking export markets for their products and services. As the world recovers from the recent prolonged recession, electricity demand is rising. Once again electricity is the engine of growth. Already utilities are planning to add new generating capacity. Canadian nuclear resources, technology and skilled people are proven and available. By seizing the opportunities which are opening up for us, a properly recognized nuclear industry can make a vital contribution to Canada's economic renewal. This brief has been prepared by the Canadian Nuclear Association (CNA) in response to the challenge issued to Canadians in Finance Minister Michael Wilson's document 'A New Direction for Canada'. This brief responds in terms of the major policy issues and opportunities as seen by the Canadian nuclear industry.

39702 **(INIS-mf—11278) Intervention of the Canadian Nuclear Association to the National Energy Board. Order no. EH-R-2-81.** (Canadian Nuclear Association, Toronto, Ontario). [1982]. 8p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88703279/JAW.

This submission from the Canadian Nuclear Association to the National Energy Board of Canada was made in support of the application by the New Brunswick Electric Power Commission to increase its electricity exports from the Point Lepreau nuclear sta-

tion to the New England states from 205 MW to 335 MW. The Canadian Nuclear Association felt that their support was justified in view of the fact that the CANDU nuclear reactor had proven itself to be a safe, reliable and economic source of electric generation. They felt the 630 MW CANDU station at Point Lepreau, New Brunswick would have sufficient generating capacity to export 335 MW for a ten-year period.

2105 Power Reactors, Breeding

REFER ALSO TO CITATION(S) 39256, 39696, 39796, 39805, 39960, 40288, 40721

39703 **(ANL—8012067) Determination of temperature and phase distributions in irradiated U-Pu-Zr Fuel.** Lahm, C.E. (Argonne National Lab., IL (USA); Idaho Univ., Moscow (USA)). Feb 1988. Contract W-31109-ENG-38. 54p. NTIS, PC A04/MF A01;1; GPO Dep. Order Number DE88012067/JAW.

Irradiation of LMFBR (Liquid Metal Fast Breeder Reactor) fuel produces significant changes in the thermophysical properties and the structure of the fuel during its lifetime. These changes in properties can be quite large and affect the operating temperatures of the fuel. An experimental subassembly, X423, containing six fuel compositions based on the U-Pu-Zr system, was irradiated in Experimental Breeder Reactor-II (EBR-II) and examined at 1 at.% burnup. Fission gas porosity was measured using an optical image analysis system to provide input for a model of a fuel element analysed with the thermal-hydraulic code THT-B. The model was structured to allow discrete radial fuel compositions and properties based on the measured porosity. This model was subsequently used to determine temperatures and to predict the fuel phases present.

39704 **(CEA-CONF—9133) Cutting by cracking hexagonal tubes of fast fuels.** Eymery, R.; Colas, J.; Pellier, R.; Chavand, J.; Peccoud, M. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. de Genie Radioactif; CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France). Inst. de Recherche Technologique et de Developpement Industriel (IRDI)). 1987. 4p. (In French). (CONF-870801—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88753885/JAW.

From International conference on nuclear fuel reprocessing and waste management (RECOD '87); Paris, France (24 Aug 1987).

Before reprocessing fuel pins should be extracted from the hexagonal tube few millimeter-thick, because of swelling axial removal is impossible and the tube should be cut lengthwise. Mechanical and laser cutting are not retained and dismantling is obtained by cracking. In this process a line is heated in surface by the TIG process (Tungsten Inert Gas) and in the heat affected zone embrittlement is produced by a metal wire, which melts and is introduced in grain boundaries of austenitic steel producing cracks. Tests are realized on 4 fuel assemblies of Phenix reactor.

39705 **(CEA-CONF—9181) EIDOMATIX: automatic control system for welds by numerical X-ray radiography.** Darier, P.; Favier, C.; Furlan, J. (CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France). Inst. de Recherche Technologique et de Developpement Industriel (IRDI)). 1987. 5p. (CONF-8610413—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88753593/JAW.

From Meeting on expert systems in nuclear field: diagnosis, maintenance, decision aid; Paris, France (14 Oct 1986).

39706 **(CEA-DAS—446e) Sodium-concrete reactions experiments and code development.** Casselman, C.; Malet, J.C.; Dufresne, J.; Bolvin, M. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Inst. de Protection et de Surete Nucleaire). Jan 1988. 14p. (CONF-860501—). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88753600/JAW.

From Conference on the science and technology of fast reactor safety; Channel Islands, UK (12 May 1986).

Hypothesis of hot sodium leak in a fast breeder reactor implies, for the safety organism to consider spillage of sodium on concrete. This safety analysis involves the understanding of sodium-concrete reactions, the knowledge of their consequences and to test the choiced preventive solutions. In association with EDF, the nuclear safety department had carried out an extensive experimental program, the different parts of which are connected with each aspect of this problem: - firstly, interaction between sodium and bare surface of usual concrete; - secondly, the case of a sodium spillage on a concrete surface covered with a defected liner; - thirdly, special concrete tests for a comparison with usual concrete behavior, in direct contact with hot sodium; - at last, a test which concerns a new design with a layer of the selected concrete protected with a defected liner. On the same time, theoretical work leads to elaborate a physical model to describe temporal evolution of thermal and chemical decomposition of a concrete slab under hot sodium action. SORBET-REBUS system will use quoted above test results to its validation.

39707 **(CEA-DRNR-P—356) BDI: the Cadarache data bank for LMBFR integral experiment data.** Rimpault, G.; Reynaud, G. (CEA Centre d'Etudes Nucleaires de Cadarache, 13 - Saint-Paul-les-Durance (France). Dept. des Reacteurs a Neutrons Rapides). Sep 1986. 10p. (CONF-8609385—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88752411/JAW.

From 29. reunion NEACRP; Ontario, Canada (22 Sep 1986).

The Integral Data Bank is part of the procedure to create the so-called neutronic formulaire with which every design calculation is performed with associated uncertainty. A modern way to store the integral data has been set up in order to handle and recalculate easily with a standard procedure (fig. 1) each experimental programme. A direct access way to read the data allows an automatic way to obtain the calculation/experiment discrepancies associated with a particular data base. The BDI has proved to be fully operational and has been used with the new nuclear data file JEF1. In the present version of the BDI more than 140 experiments (critical mass, spectrum indexes, buckling, etc...) both from MASURCA and SNEAK critical experiments are documented and stored in an easy-to-retrieve from. Also included are irradiation experiments in PHENIX and the STEK fission product related experiments. Future plans of development concern reactivity measurements in critical assemblies, irradiation experiments and start-up experiments of SUPER PHENIX and ZEBRA critical experiments.

39708 **(CEA-DRNR-P—358) Some investigations on the reactivity scale for the Super-Phenix 1 start-up experiment analysis.** D'Angelo, A.; Vuillemin, B.; Cabrillat, J.C. (CEA Centre d'Etudes Nucleaires de Cadarache, 13 - Saint-Paul-les-Durance (France). Dept. des Reacteurs a Neutrons Rapides). Sep 1986. 21p. (CONF-8609385—). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88752410/JAW.

From 29. reunion NEACRP; Ontario, Canada (22 Sep 1986).

Possible sources of uncertainties in the effective fraction of delayed neutrons (β/sub eff/) calculations are investigated, in particular in relation to SUPER PHENIX. Method uncertainties, reaction rate bias and uncertainties and delayed neutron parameters uncertainties have been considered. Moreover, β/sub eff/ uncertainties have been compared in SUPER PHENIX and in some experimental configurations of MASURCA, where control rod experiments have been performed, in order to assess eventual bias among critical experiments and power reactor data. Finally, some integral β/sub eff/ measurements performed in SNEAK have been reanalysed, consistently with the above mentioned uncertainty analysis.

39709 **(CEA-DRNR-P—363) Fatigue dimensionnement for heat exchanger tubes of Super Phenix steam generators.** Sperandio; Martin, P. (CEA Centre d'Etudes Nucleaires de Cadarache, 13 - Saint-Paul-les-Durance (France). Dept. des Reacteurs a Neutrons Rapides). Oct 1986. 16p. (In French). (CONF-8610264—). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88752408/JAW.

From 2. international seminar on standards and structural analysis is elevated temperature applications for reactor technology; Venice, Italy (15 Oct 1986).

After a brief description of the 3 models of steam generators, the authors analyse the cracks fatigue observed on the tubes. At this fatigue phenomena is superposed a stress caused by the helicoi-

dal conception of the bundles. The analysis of operation sequencies indicates that the cracks are connected with start-up, shut down and principally with the movements of the dry-out zone. Based on these results, a dimensional analysis for Super Phenix has shown that the operation sequencies gives a negligible damage. To resolve incertitudes on thermohydraulic phenomena new experiments are undertaken.

39710 **(CEA-DRNR-P—364) Use of covariance informations for integral experiment planning.** Palmiotti, G.; Salvatores, M. (CEA Centre d'Etudes Nucleaires de Cadarache, 13 - Saint-Paul-les-Durance (France). Dept. des Reacteurs a Neutrons Rapides). Nov 1986. 15p. (CONF-861193—). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88752409/JAW.

From IAEA specialists' meeting on covariance methods and practices in the field of nuclear data; Rome, Italy (17 Nov 1986).

The present note describes briefly the application of basic data covariance matrix informations to the optimization of integral experiments, in order to reduce design parameter uncertainties.

39711 **(CONF-8806102—1) Development of a high temperature, high sensitivity fission counter for liquid metal reactor in-vessel flux monitoring.** Valentine, K.H.; Williams, J.A.; Shepard, R.L.; Falter, D.D.; Hahs, C.A. (Oak Ridge National Lab., TN (USA)). 1988. Contract AC05-84OR21400. 9p. NTIS, PC A02/MF A01;1; GPO Dep. Order Number DE88008079/JAW.

From Specialists' meeting on instrumentation and reactor core assessment; Cadarache, France (7 Jun 1988).

Advanced liquid metal reactor concepts such as the Sodium Advanced Fast Reactor (SAFR) and the Power Reactor Inherently Safe Module (PRISM) have relatively large pressure vessels that necessitate in-vessel placement of the neutron detectors to achieve adequate count rates during source range operations. It is estimated that detector sensitivities of 5 to 10 counts{center←dot}s{ center←dot}/sup {minus}1/{center←dot}[neutron/ (cm²{center←dot}s)]/sup {minus}1/ will be required for the initial core loading. The Instrumentation and Controls Division of Oak Ridge National Laboratory has designed and fabricated a fission counter to meet this requirement which is also capable of operating in uncooled instrument thimbles at primary coolant temperatures of 500 to 600{degree}C. Components are fabricated from Inconel-600, and high temperature alumina insulators are employed. The transmission line electrode configuration is utilized to minimize capacitive loading effects.

39712 **(UJV—7611-T) Finite element analysis of turbulent flow in fast reactor fuel subassembly elementary flow cell.** Muehlbauer, P. (Ustav Jaderneho Vyzkumu CSKAE, Rez (Czechoslovakia)). Mar 1987. 15p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88701708/ JAW.

The method is described of calculating fully developed longitudinal steady-state turbulent flow of an incompressible fluid through an infinite bundle of parallel smooth rods, based on the finite element method and one-equation turbulence model. Theoretical calculation results are compared with experimental results. (author). 5 figs., 3 refs.

39713 **(WAPD-TM—1600) Water cooled breeder program summary report (LWBR [Light Water Breeder Reactor] development program).** (Bettis Atomic Power Lab., West Mifflin, PA (USA)). Oct 1987. Contract AC11-76PN00014. 173p. NTIS, PC A08/MF A01;1; GPO Dep. Order Number DE88010121/JAW.

The purpose of the Department of Energy Water Cooled Breeder Program was to demonstrate pratical breeding in a uranium-233/thorium fueled core while producing electrical energy in a commercial water reactor generating station. A demonstration Light Water Breeder Reactor (LWBR) was successfully operated for more than 29,000 effective full power hours in the Shippingport Atomic Power Station. The reactor operated with an availability factor of 76% and had a gross electrical output of 2,128,943,470 kilowatt hours. Following operation, the expended core was examined and no evidence of any fuel element defects was found. Nondestructive assay of 524 fuel rods determined that 1.39 percent more fissile fuel was present at the end of core life than at the beginning, proving that breeding had occurred. This demonstrates the existence of a vast source of electrical energy using plentiful domestic thorium potentially capable of supplying the entire national need for many centuries. To build on the successful design and operation of the Shippingport Breeder Core and to provide the technology to implement this concept, several reactor designs of large breeders and prebreeders were developed for commercial-sized plants of 900--1000 Mw(e) net. This report summarizes the Water Cooled Breeder Program from its inception in 1965 to its completion in 1987. Four hundred thirty-six technical reports are referenced which document the work conducted as part of this program. This work demonstrated that the Light Water Breeder Reactor is a viable alternative as a PWR replacement in the next generation of nuclear reactors. This transition would only require a minimum of change in design and fabrication of the reactor and operation of the plant.

2106 Power Reactors, Auxiliary, Mobile, Package, And Transportable

REFER ALSO TO CITATION(S) 39521, 40096

39714 **(CONF-880122—14) Power and energy requirements for electromagnetic launchers.** Lottes, P.A.; Holtz, R.E.; Uherka, K.L. (Argonne National Lab., IL (USA)). Jul 1987. Contract W-31109-ENG-38. 5p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE88010043/JAW.

From 5. symposium on space nuclear power systems; Albuquerque, NM, USA (11 Jan 1988).

A large data base exists covering almost all aspects of the requirements for the successful development of electromagnetic launchers. To extend the use of electromagnetic launchers to the limits of technology for such exotic applications as hypervelocity weaponry or space launch systems, it is useful to examine the energy and power requirements for such uses. One way of examining the power and energy limits is to purposely neglect all system losses in order to determine the minimum power and energy requirements. Actual power requirements will most likely be higher by at least a factor of three. Calculations are presented for minimum power requirements, launch acceleration time, projectile kinetic energy, and projectile inertial force as a function of projectile mass, projectile terminal velocity, and length of the launch tube. Results of these calculations are presented in this report.

39715 **(JAERI—1309) STEADY-SHIP: a computer code for three-dimensional nuclear and thermal-hydraulic analyses of marine reactors.** Itagaki, Masafumi; Naito, Yoshitaka; Tokuno, Yukio; Matsui, Yasushi. (Japan Atomic Energy Research Inst., Tokyo). Jan 1988. 98p. (In Japanese). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88754106/JAW.

A code STEADY-SHIP has been developed to calculate three-dimensional distributions of neutron flux, power and coolant temperature in the reactor core of the nuclear ship MUTSU. The code consists of two parts, that is, a few-group three-dimensional neutron diffusion module DIFFUSION-SHIP and a thermal-hydraulic module HYDRO-SHIP: In the DIFFUSION-SHIP the leakage iteration method is used for solving the three-dimensional neutron diffusion equation with small computer core memory and short computing time; The HYDRO-SHIP performs the general thermal-hydraulic calculation for evaluating feedbacks required in the neutronic calculation by the DIFFUSION-SHIP. The macroscopic nuclear constants are generated by a module CROSS-SHIP as functions of xenon poison, fuel temperature, moderator temperature and moderator density. A module LOCAL-FINE has the capability of computing a detailed rod power distribution for each local node in the core, using the boundary conditions on the surface of the node which were supplied by the STEADY-SHIP whole-core calculation. The applicability of this code to marine reactors has been demonstrated by comparing the computed results with the data measured during the MUTSU land-loaded core critical experiments and with the data obtained during the hot-zero-power tests performed for the actual MUTSU plant.

2107 Regulation And Licensing

REFER ALSO TO CITATION(S) 39696, 39782, 39865, 39866, 39948, 40037

39716 (EPRI-NP—5639) Guidelines for piping system reconciliation (NCIG-05, Revision 1): Final report. Mikitka, R.W.; Reedy, R.F. (Reedy Associates, Inc., Los Gatos, CA (USA)). May 1988. 50p. Research Reports Center, Box 50490, Palo Alto, CA 94303;1. Order Number TI88009897/JAW.

This document provides guidelines for implementing the Pressure Vessel Research Committee (PVRC) Technical Position on piping system installation tolerances. Specific tolerances are provided for piping dimensions, component weights, and support locations and orientations. Piping systems that meet the specified tolerances are acceptable without need for further reconciliation or reanalysis. When the specified tolerances are exceeded, the out-of-tolerance item must be evaluated by the Designer. Recommendations are provided for performing these design evaluations.

39717 (EPRI-NP—5746) Evaluation of simulator discrepancies on the basis of operational impact: Final report. Gaddy, C.D.; Pellechi, M.S.; Praskievicz, J.C.; Trent, C.S. (General Physics Corp., Columbia, MD (USA)). Apr 1988. 82p. /MF A01 - Research Reports Center, Box 50490, Palo Alto, CA 94303;1. Order Number TI88010462/JAW.

Nuclear power plant training simulators today play an important role in the training and testing of licensed operators. As a result, the impact of any shortcoming and the determination of the priority of these limitations are issues continually confronting every simulator owner. This report attempts to address these issues by providing a methodology for evaluating the operational impact of simulator discrepancies. By evaluating the operational impact, the simulator owner can decrease the probability of control room errors that can be attributed to differences between the training simulator and the reference plant. The report also includes (1) guidance on assigning priority levels in view of practical considerations (e.g., training schedule, resources), (2) a discussion of the application of the methodology in a test case, and (3) an examination of some alternatives to simulator model reconstruction or computer upgrading.

39718 (NUREG—0940-Vol.7-No.1) Enforcement actions: Significant actions resolved: Quarterly progress report, January-March 1988. (Nuclear Regulatory Commission, Washington, DC (USA). Office of Enforcement; Nuclear Regulatory Commission, Washington, DC (USA)). Jun 1988. 312p. NTIS, PC A14/MF A01 - GPO. Order Number TI88012642/JAW.

This compilation summarizes significant enforcement actions that have been resolved during one quarterly period (January-March 1988) and includes copies of letters, Notices, and Orders sent by the Nuclear Regulatory Commission to licensees with respect to these enforcement actions. It is anticipated that the information in this publication will be widely disseminated to managers and employees engaged in activities licensed by the NRC, so that actions can be taken to improve safety by avoiding future violations similar to those described in this publication.

39719 (NUREG/CP—0091-Vol.3, pp 153-168) Regulatory options for nuclear plant license renewal. Seth, S.; Abel, P.; Hughes, A.; Malone, G. (MITRE Corp., McLean, VA (USA)). Feb 1988. NTIS, PC A 18 - GPO. Order Number TI88006305/JAW. (CONF-8710111—Vol.3).

From 15. water reactor safety information meeting; Gaithersburg, MD, USA (26 Oct 1987).

The US Nuclear Regulatory Commission (NRC) is developing a policy for renewing the operating licenses of commercial nuclear power plants. Several license renewal issues have been identified as a result of NRC's public comment process and its own consideration of the regulatory requirements for relicensing. This paper provides a discussion of the safety issues associated with license renewal and of the options identified to address those issues. The key safety issues are related to the age-related degradation, licensing design basis, and operations and management aspects of plants to be relicensed. The regulatory options are described in terms of the technical information needed for safety review of license renewal applications. The options are intended to be further evaluated and integrated to provide a basis for license renewal policy development.

39720 (NUREG/CR—5147) Fundamental attributes of a practical configuration management program for nuclear plant design control. Klein, S.M. (Nuclear Regulatory Commission, Washington, DC (USA). Div. of Licensee Performance and Quality Evaluation; ERC International, Plymouth Meeting, PA (USA). WESTEC Power Engineering Div.). Jun 1988. 81p. NTIS, PC A05/MF A01 - GPO. Order Number TI88012821/JAW.

This summarizes the results of an evaluation of findings identifies during a number of Safety-System Functional Inspections and Safety System Outage Modification Inspections which are related to configuration management for nuclear plant design control. A computerized database of these findings was generated from a review of the design inspection reports. Based on the results of the evaluation, attributes of a configuration management program were developed which are responsive to minimizing these types of inspection findings. Incorporation of these key attributes is considered good practice in the development of a configuration management program for design control at operating nuclear plants.

39721 (NUREG/CR—5151) Performance-based inspections. Hawkins, F.; Johnson, J.H.; Liner, R.T.; Putnam, C.H. (Nuclear Regulatory Commission, Washington, DC (USA); Weirich and Associates (USA); Science Applications International Corp., McLean, VA (USA)). Jun 1988. 25p. (SAIC—88/3014). NTIS, PC A03/MF A01 - GPO;1. Order Number TI88011669/JAW.

This report describes the concept of performance-based inspections that is being taught in NRC's training course, "Inspecting for Performance." This concept has been endorsed and is being implemented by the Nuclear Regulatory Commission (NRC). NRC performance-based inspections concentrate on activities that impact plant reliability and safety. The inspections begin with performance-based observations, and then the inspectors let discrepancies or uncertainties lead to inspection of other areas, such as quality verification organization effectiveness, training adequacy, and procedural controls. This inspection approach departs from past NRC practices that emphasized documentation and program review as a means to measure operational safety. The first goal of performance-based inspections is to improve the NRC inspector's ability to accurately evaluate plant safety and reliability. This goal will be achieved by increasing the inspector's emphasis on actual observation of ongoing facility work activities and reducing the emphasis on document and program reviews. The secondary goal of performance-based level inspections is to encourage licensees to manage their facilities in a performance-based manner.

2108 Economics

REFER ALSO TO CITATION(S) 39646, 39701, 39782, 39801, 39866, 40036

39722 (EPRI-NP—5764) PWR (pressurized water reactor) water treatment improvements: Cost-benefit analysis: Final report. Siegwarth, D.P.; Bickerstaff, J.A.; Chakravorti, R. (Electric Power Research Inst., Palo Alto, CA (USA); NWT Corp., San Jose, CA (USA); Gibbs and Hill, Inc., San Jose, CA (USA)). May 1988. 66p. Research Reports Center, Box 50490, Palo Alto, CA 94303;1. Order Number TI88010310/JAW.

Pressurized water reactor steam generators and turbines have experienced a variety of corrosion problems as a result of ionic, corrosion product and oxidizing species transport into the steam generators. This project considered the design, cost and benefit of equipment modifications and additions which would decrese secondary cycle impurity transport. Improving condenser integrity, adding full-flow condensate polishers, providing low dissolved oxygen in makeup water and installation of all-ferrous heat exchangers are four changes that can significantly improve secondary water quality. Conceptual designs and costs of these four concepts at a 1160 MWe pressurized water reactor are summarized. The ex-

pected chemistry and operational benefits are discussed, and a cost-benefit analysis is given.

39723 (EUR—11149) Economic comparison of management modes for contaminated metal scrap. Janberg, K. (Commission of the European Communities, Luxembourg). 1987. 12p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88753955/JAW.

This report presents an economic study of the three following management modes for contaminated metal scrap: - decontamination of scrap metal followed by release, - direct melting of scrap metal, followed by release or restricted reuse, - super-compaction followed by disposal as radioactive waste. The present study, which refers to conditions prevailing in Germany, includes reviews of the contaminated scrap arisings, of experience with scrap management and of the licensing conditions for metal recycling. The results obtained during the treatment of more than 140 t of contaminated scrap metal show that: - super-compaction is the best procedure for all mixed metallic wastes of small dimensions and complex geometries, as decontamination is very costly in such a case and the melting would lead to undefined metallurgical products; - decontamination is recommendable for simple geometries and activities higher than the regulatory upper limit for melting in an industrial foundry (74 Bq/g); - direct melting for lower activity levels is gaining in competitiveness and has a good chance to be the best solution, in particular when the free use levels will be reduced below the currently accepted levels in Germany.

39724 (IAE—4361/3) Power peaking effect on the damage fuel assembly pre-term unloading. Ajrapetyan, A.A.; Shevelev, Ya.V. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1986. 19p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703132/JAW.

A simple and rather precise method for calculation of the reactor campaign in one-group one-dimensional (by radius) approximation is suggested. Approximate optimization of refueling strategy is conducted. The effect of field inhomogeneity in reactors close to optimum by the value of the economic criterion on detriment of fuel assembly failure is investigated. The calculations revealed that square dependence of the detriment on fuel subburn-up in a removed fuel assemby disclosed under the analysis of a completely equalized reactor preserves its value in a non-equalized reactor as well. 5 refs.; 6 tabs.

39725 (INIS-mf—11097, pp 34-46) Development of Czechoslovak nuclear power complex. Rajci, T. 1986. (In Slovak). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88780069/JAW.

In Collection of the institute's papers 1985.

The research project "Development of the Czechoslovak nuclear power complex" was undertaken by several Czechoslovak institutions and was coordinated by the Research Institute of the Fuel and Power Complex in Bratislava. Involved in the project was a staff of 170 people. 274 reports were pulished and the cost approached 70 mill. Czechoslovak crowns. The results are characterized of all six partial tasks. Basic information was prepared for the forecast of the solution of fuel and power problems in Czechoslovakia up to the year 2000 and their prospects up to the year 2020. Program MORNAP was written for the development of nuclear power, which models the operation of a power generation and transmission system with a selectable number of nuclear power plants. Another partial task related to the fuel cycle of nuclear power plants with respect to long-term provision and management of nuclear fuel. Nuclear safety was split into three problem groups, viz.: system safety of nuclear power plant operation; radiation problems of nuclear power plant safety; quality assurance of nuclear power plant components. The two remaining tasks were devoted to nuclear power engineering and to civil engineering. (Z.M.). 3 tabs., 1 refs.

39726 (INIS-mf—11097, pp 145-153) Problems of power plant capital demands. Slechta, V.; Bohal, L. 1986. (In Czech). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88780069/JAW.

In Collection of the institute's papers 1985.

The problems are discussed of requirements for investment for power plants in Czechoslovakia. Since the construction was finished of coal-burning 110 MW power plants with six power units, specific capital cost has steadily been growing. The growth amounts to 6 to 8% per year while the principle has been observed that specific capital cost decreases with increased unit power. Attention is paid to the cost of the subcontractors of the building and technological parts of a power plant and to the development of productivity of labour. A comparison is tabulated of cost for coal-burning power plants with 100 MW and 200 MW units and for nuclear power plants with WWER-440 reactors. Steps are suggested leading to a reduction of the capital cost of nuclear power plants. It is stated that should not these steps be taken, the envisaged development of nuclear power would be unbearable for the Czechoslovak national economy. (Z.M.). 8 tabs., 3 refs.

39727 (INIS-mf—11275) Response to the Federal Finance Minister's 'A new direction for Canada'. (Canadian Nuclear Association, Toronto, Ontario). Mar 1985. 15p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703276/JAW.

This brief was presented by the Canadian Nuclear Association in response to the Canadian Federal Finance Minister's request for consultation with the business community particularly in view of his document, 'A New Direction for Canada'. The Canadian Nuclear Association feels that the nuclear industry can make a substantial contribution to the economic renewal of Canada by exploiting Canada's proven technologies, natural resources, human resources and marketing skills. The brief identifies strategic opportunities facing the nuclear industry at home and abroad and makes recommendations as to how they can be achieved. The main recommendations are that public support of nuclear research and development be maintained, that federal initiatives be used to facilitate nuclear exports of all types and to encourage foreign investment, that policies promoting increased use of electricity-based technology in industry be adopted, that the construction of a second nuclear reactor in New Brunswick be supported, that the CANDU option be maintained, and that the federal government continue to press other nuclear supplier nations to establish a common set of rules for international trade in nuclear materials and technology.

39728 (INIS-mf—11277) Response to the Federal Finance Minister's invitation for industry consultation. Executive brief to federal government 'Recommendations with respect to the 1986 budget and Canada's nuclear assets'. (Canadian Nuclear Association, Toronto, Ontario). Jan 1986. 6p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88703278/JAW.

Attached facts sheet.

In March 1985, the Canadian Nuclear Association (CNA) presented an extensive brief to the Minister of Finance, Michael Wilson, in response to the challenge issued to Canadians in the Minister's document 'A New Direction for Canada'. This further brief has been prepared in the spirit of the Minister's letter to the CNA dated May 23rd, 1985 in which Mr. Wilson indicated his desire for continued participation of groups such as the CNA in the consultative process. Appended to this brief is a reference sheet entitled 'What Nuclear Energy Means to Canada'. The facts in this sheet are extracted from the 1985 brief and updated with the latest information. Since the major emphasis in energy related discussions is usually on supply and demand of hydrocarbons such as oil and gas, it may come as a suprise to most Canadians that Canada's uranium production contained twice the energy in Canada's crude oil production and exceeded the total energy in all of the country's crude and natural gas production in 1984. Another little known fact is that nuclear power will soon produce more electricity worldwide than all the world's hydro- electric plants. The CNA intends to more widely disseminate this knowledge to the Canadian public. As part of that process it is hoped that the importance of uranium both for domestic use and exports, and Canada's success in harnessing nuclear power for peaceful and beneficial applications, will be fully reflected in decisions and statements related to the development of government fiscal and energy policies. The industry wishes to maintain an ongoing dialogue with government in the following matters: substitution of non-renewable by renewable energy; assur-

ance that electricity sales will not be taxed; maintenance of an open market for uranium with the U.S.A.; continued support in research and development; approval of the Point Lepreau proposal and federal government support for sale of a reactor to Turkey.

39729 (NUREG/CR—5138) Validation of generic cost estimates for construction-related activities at nuclear power plants: Final report. Simion, G.; Sciacca, F.; Claiborne, E.; Watlington, B.; Riordan, B.; McLaughlin, M. (Science and Engineering Associates, Inc., Albuquerque, NM (USA)). May 1988. 50p. (SEA—87-253-04-A:1). NTIS, PC A03/MF A01 - GPO;3. Order Number TI88010186/JAW.

This report represents a validation study of the cost methodologies and quantitative factors derived in Labor Productivity Adjustment Factors and Generic Methodology for Estimating the Labor Cost Associated with the Removal of Hardware, Materials, and Structures From Nuclear Power Plants. This cost methodology was developed to support NRC analysts in determining generic estimates of removal, installation, and total labor costs for construction-related activities at nuclear generating stations. In addition to the validation discussion, this report reviews the generic cost analysis methodology employed. It also discusses each of the individual cost factors used in estimating the costs of physical modifications at nuclear power plants. The generic estimating approach presented uses the {open←quotes}greenfield{close←quotes} or new plant construction installation costs compiled in the Energy Economic Data Base (EEDB) as a baseline. These baseline costs are then adjusted to account for labor productivity, radiation fields, learning curve effects, and impacts on ancillary systems or components. For comparisons of estimated vs actual labor costs, approximately four dozen actual cost data points (as reported by 14 nuclear utilities) were obtained. Detailed background information was collected on each individual data point to give the best understanding possible so that the labor productivity factors, removal factors, etc., could judiciously be chosen. This study concludes that cost estimates that are typically within 40% of the actual values can be generated by prudently using the methodologies and cost factors investigated herein.

22 NUCLEAR REACTOR TECHNOLOGY

39730 (AD-A—191568/5/XAB) Nuclear Power Engineering (selected articles). (Air Force Systems Command, Wright-Patterson AFB, OH (USA). Foreign Technology Div.). 18 Mar 1988. Translation of He Dong Li Gong Cheng (China), Vol. 8, No. 2, 13-17(21-36, 62-65 Apr 1987). (FTD-ID(RS)T—1316-87). 70p. NTIS, PC A04/MF A01.

Availability: Document partially illegible.

Contents include: a control rod drive line design for Qinshan nuclear power plant; the accident of Chernobyl nuclear power plant and its effects; and prediction of nuclear-fuel consumption in China.

2201 Theory And Calculation

REFER ALSO TO CITATION(S) 39606, 39768, 41969, 41970, 41971, 41972, 41973, 41974, 41975, 41976, 41977, 41978, 41979, 41980, 41981, 41982, 41983, 41984, 41985

39731 (AERE-M—3654) FISPACT - user manual. Forrest, R.A.; Endacott, D.A.J. (UKAEA Harwell Lab. Nuclear Physics Div.). Mar 1988. 14p. H.M. Stationery Office, London, price Pound 4.00.

The FISPACT inventory code calculates activation of material irradiated in a neutron flux. This manual explains how to access data libraries suitable for fusion reactor activation and the method of specifying the details of irradiation by a system of codewords.

39732 (FEI—1824) Methods for calculting functionals of quasistationary neutron flux in a reactor by the Monte Carlo method. Polevoj, V.B. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk. Fiziko-Ehnergeticheskij Inst.). 1987. 8p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88701567/JAW.

Consideration is being given to interpretation of α/V member of the quasistationary transport equation as the cross-section of delta scattering with particle multiplication and to probabilistic model for the weighting simulation of the solution of this equation. It is suggested to determine α/sub 0/ eigenvalue by various methods on the basis of calculation the dependence of $\lambda(\alpha)$ generation time for assigned reactivity. 12 refs.

39733 (INIS-BR—952) Spatially dependent burnup implementation into the nodal program based on the finite element response matrix method. Yoriyaz, H. (Instituto de Pesquisas Energeticas e Nucleares, Sao Paulo (Brazil)). 1986. 93p. (In Portuguese). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88701606/JAW.

In this work a spatial burnup scheme and feedback effects has been implemented into the FERM ('Finite Element Response Matrix')program. The spatially dependent neutronic parameters have been considered in three levels: zonewise calculation, assembly wise calculation and pointwise calculation. Flux and power distributions and the multiplication factor were calculated and compared with the results obtained by CITATIOn program. These comparisons showed that processing time in the Ferm code has been hundred of times shorter and no significant difference has been observed in the assembly average power distribution.

39734 (ITEF—38(1987)) Three-dimensional calculation of adjoint neutron flux in a heterogeneous reactor and evaluation of regulating rod differential weight. Grigor'ev, S.P.; Malofeev, V.M. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1987. 12p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88701637/JAW.

In frames of a three-dimensional model of a heterogeneous reactor the method for evaluation of the system criticality change due to the reactor physical and geometrical parameter variations is presented. The problem on displacement of complex axial control elements is considered in detail. Evaluation of criticality change is carried out using the perturbation theory on the base of solutions of direct and adjoint equations of three-dimensional theory for a heterogeneous reactor. Results of numerical calculations using the program realizing the given method are presented. Change of cryticality due to fuel assembly exchange and partial displacement of continuous steel control elments in natural uranium heavy water reactor is investigated. 4 refs.; 4 figs.

39735 (ITEF—108(1985)) P/sub 3/-approximation for calculating a nuclear reactor cell with gaseous medii and vacuum. Raevskaya, V.E. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1985. 64p. (In Russian). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88701638/JAW.

The work is aimed at grounding the possibility of applying P/sub 3/-approximation for calculating neutron fields in a reactor cell with gas and vacuum. Analytical solutions in a cylindrical vacuum layer, matrix run formulae for vacuum layers, addition theorem for neutron field in the cluster central zone between the rods located in vacuum, formulae for mean neutron fluxes in vacuum cylindrical layers and the cluster central zone with vacuum between the rods are derived. Results of multizone cylindrical cell and cluster calculations, performed in the P/sub 3/-approximation according to the CLUST and other programs agree well with each other. 8 refs.; 14 figs.; 19 tabs.

39736 (JAERI-M—88-035) Calculation code of heterogeneity effects for analysis of small sample reactivity worth. Sample size effect and intracell adjoint heterogeneity effect. Okajima, Shigeaki; Mukaiyama, Takehiko; Maeda, Akio. (Japan Atomic Energy Research Inst., Tokyo). Mar 1988. 37p. (In Japanese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88754118/JAW.

The discrepancy between experimental and calculated central reactivity worths has been one of the most significant interests for the analysis of fast reactor critical experiment. Two effects have

been pointed out so as to be taken into account in the calculation as the possible cause of the discrepancy; one is the local heterogeneity effect which is associated with the measurement geometry, the other is the heterogeneity effect on the distribution of the intracell adjoint flux. In order to evaluate these effects in the analysis of FCA actinide sample reactivity worth the calculation code based on the collision probability method was developed. The code can handle the sample size effect which is one of the local heterogeneity effects and also the intracell adjoint heterogeneity effect.

39737 Application of the "reactivity constraint approach" to automatic reactor control. Bernard, J.A.; Henry, A.F.; Lanning, D.D. (Massachusetts Institute of Technology, Nuclear Reactor Lab., 138 Albany Street, Cambridge, MA (US)). *Nuclear Science and Engineering;* **98**: No. 2, 87-95(Feb 1988).

The "reactivity constraint approach" is described and demonstrated to be an effective and reliable means for the automatic control of power in nuclear reactors. This approach functions by restricting the effect of the delayed neutron populations to that which can be balanced by an induced change in the prompt population. This is done by limiting the net reactivity to the amount that can be offset by reversing the direction of motion of the automated control mechanism. The necessary reactivity constraints are obtained from the dynamic period equation, which gives the instantaneous reactor period as a function of the reactivity and the rate of change of reactivity. The derivation of this equation is described with emphasis on the recently obtained "alternate" formulation. Following a discussion of the behavior of each term of this alternate equation as a function of reactivity, its use in the design and operation of a nonlinear, closed-loop, digital controller for reactor power is in the design and operation of a nonlinear, closed-loop, digital controller for reactor power is described. Details of the initial experimental trials of the resulting controller are given.

39738 Three-dimensional nodal solution for the frequency-dependent neutron-diffusion equation. Melaibari, A.M. Ames, IA; Iowa State Univ. (1987). 123p. University Microfilms Order No. 87-21,909.

Thesis (Ph. D.).

This research involves the development of a three-dimensional nodal code that calculates the Fourier transformed regular or adjoint neutron flux for a nuclear reactor. This numerical technique can be used in the nuclear reactor noise-analysis field for identifying and locating vibrating reactor-core components. The mathematical equations were developed and two types of solutions were obtained. The first solution was a modification of a three-dimensional nodal model developed to handle multigroup neutron diffusion equations. In this model, the Fourier transformed fluxes were expanded in the Legendre polynomial form. The second is an analytical procedure developed for a simple geometry and material composition. In the analytical model, the frequency-dependent flux was expanded in the eigenfunctions of the Helmholtz equation which yielded a series form solution. This solution was used to verify the validity of the nodal numerical technique. The nodal computer code was tested for 8, 64, and 216 node problems. Moreover, it was examined for frequencies inside and outside the plateau region of the zero power reactor transfer function.

39739 Development of two-group, two-dimensional, frequency-dependent detector adjoint function based on the nodal method. Khericha, S.T. Ames, IA; Iowa State Univ. (1987). 99p. University Microfilms Order No. 87-16,782.

Thesis (Ph. D.).

A concept of local/global components, based on the frequency-dependent detector adjoint function, and a nodalization technique was utilized in development of one- and two-dimensional computer codes to calculate the response of a detector to a vibrating absorber in reactor cores. The frequency-dependent detector adjoint functions presented by complex equations were expanded into real and imaginary parts. In the nodalization technique, the flux is expanded into polynomials about the center point of each node. The phase angles and the magnitudes of the two-energy group detector adjoint functions were calculated for a neutron detector located in the middle of the south core tank of the Iowa State University UTR-10 reactor using a one-dimensional computer code. Results were compared with the exact analytical solution and were found to be within 2% of the values obtained from the analytical solution. Using a two-dimensional computer code, the phase angle and the magnitude of the one-energy group detector adjoint function was calculated for a detector located in the center of a 200 cm x 200 cm reactor. Results were within 3% of the values obtained from the analytical solution and the computer code EXTERMINATOR.

2202 Components And Accessories

REFER ALSO TO CITATION(S) 39602, 39716, 39780, 39781, 39808, 39857, 39861, 39873, 39874, 39875, 39876, 39877, 39878, 39879, 39881, 39882, 39884, 39885, 39886, 39919, 39920, 40265, 40701

39740 (DPST—88-472) Reactor materials program: LBB assessment - heat exchangers. Sindelar, R.L. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Plant). 15 Apr 1988. Contract AC09-76SR00001. 102p. NTIS, PC A06/MF A01;1; GPO Dep. Order Number DE88011671/JAW.

A credible Loss-of-Coolant Accident (LOCA) for the Savannah River Production Reactors is being defined through studies of the failure mechanisms in the components of the process water (PW) system. A component that can exhibit leakage or cracking that is readily detected prior to a large-break failure demonstrates a Leak-Before-Break (LBB) capability and would allow safe reactor shutdown well in advance of a large break. A related sequence which encompasses LBB is the Detect-Before-Break (DBB) assessment which considers inspection of the component and crack detection by leakage or visual methods to ensure integrity of the pressure boundary of the component. The LBB capability of the PW system is performed by assessing the pressure boundary integrity and determining the ability to exhibit leakage prior to an unacceptably large break for each component of the system. It has been demonstrated that pipe weldments will not fail causing a sudden double-ended-guillotine break (DEGB) in the PW system. The LBB and DBB ability of the flanges, valves and pumps has also been demonstrated. The subject of this report is the demonstration of the LBB/DBB capability of the heat exchangers in the SRP process water system. 10 figs.

39741 (EPRI-CS—5694) On-line eddy-current crack monitor: Final report. Bedrosian, G.; Chari, M.V.K.; Fealey, J.A.; Sober, T.J. (General Electric Co., Schenectady, NY (USA). Corporate Research and Development Dept.). Apr 1988. 85p. Research Reports Center, Box 50490, Palo Alto, CA 94303;1. Order Number TI88009449/JAW.

This report describes research work conducted for the Electric Power Research Institute under contract number RP1894-1, Eddy Current On-Line Monitoring for Crack Detection. The project investigated the feasibility of using electromagnetic non-destructive evaluation (NDE) techniques to monitor rotating metallic components of turbine-generators for incipient failures in an on-line mode. Turbine-generator components of particular interest were shafts, tubine discs, and generator retaining rings. Both electromagnetic analysis and laboratory experiments played a part in evaluating eletromagnetic NDE techniques for this application. This research project showed that electromagnetic NDE methods can feasibly detect and image surface-penetrating flaws in metallic objects rotating at the high peripheral speeds found in turbine-generators. A demonstration system using electromagnetic techniques was developed and produced color images in real-time of flaws in rotating laboratory test models. The system was also successfully demonstrated on a growing crack in a rotating shaft. Application of this technique to real turbine-generators will require additional effort. This report concludes with recommendations for adapting the demonstration system for use in a power plant.

39742 (EPRI-CS—5858) Rotating machinery dynamics, bearings, and seals: Symposium proceedings. Adams, M.L. (Electric Power Research Inst., Palo Alto, CA (USA); Case Western Reserve Univ., Cleveland, OH (USA)). Jun 1988. 525p. (CONF-8609427—). Unlimited audience, publicly available. Research Reports Center, Box 50490, Palo Alto, CA 94303;1. Order Number TI88011929/JAW.

From Symposium on rotating machinery dynamics, bearings, and seals; St. Louis, MO, USA (9 Sep 1986).

This EPRI-sponsored symposium on the state-of-the-art power plant Rotating Machinery Dynamics, Bearings and Seals was held on September 9-11, 1986. Its principal purpose was to bring together electric utility engineers, manufacturers and engineering consultants to interact constructively on these pertinent interrelated power plant rotating machinery topics. Twenty-two papers, reprinted in this Proceedings, were presented at four half-day sessions organized under the following topics: Utility Experience with Machinery Vibrations; Reliability, Maintenance and Life Extension; Evaluation of Drive-line Interactions; and Improvements through Retrofits. In addition, a concluding fifth session consisted of three concurrently held discussion groups covering the following topics: Generator Vibration Problems; Bearings, Lubrication Systems and Retrofit Improvements; and Vibration Monitoring and Diagnostics. Summaries of these discussion group sessions are given in this Proceedings, along with tabulated results of a symposium attendee questionnaire, list of symposium attendees and the symposium agenda.

39743 **(EPRI-NP—5854) Assessing the costs, risks, and benefits of snubber reduction: A comprehensive framework: Interim report.** Bier, V.M. (Electric Power Research Inst., Palo Alto, CA (USA); Pickard, Lowe and Garrick, Inc., Newport Beach, CA (USA)). Jun 1988. 87p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88011775/JAW.

The objective of this work is to develop a decision model for balancing the competing concerns of seismic safety, thermal stress fatigue, and plant operating costs. This model takes into account information on the seismic margins of contemporary nuclear power plant piping systems as a basis for estimating the potential for snubber reduction.

39744 **(FEI—1719) Probability distributions for variations in reactor core channel opening sections.** Kurbatov, I.M.; Chizhikova, Z.N. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk. Fiziko-Ehnergeticheskij Inst.). 1985. 18p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88701565/JAW.

The laws of probability distributions for variations in reactor core channel opening sections are determined on the assumption of equiprobable and truncated normal distributions of initial parameter variations (fuel element diameter, fuel element lattice pitch). Two types of channels are considered: simple ones, those which opening sections squares are functions of one parameter (a circle, square, equilateral triangle, hexahedron), and compound channels which opening section squares are functions of two variabls (annular channel, channels with fuel rods). The obtained laws of probability distributions for variations in reactor core channel opening sections show that nonlinear relations between the channel parameters and the square apreciably transform the square distribution function as compared to the laws of distribution of the channel parameter variations. The densitis of square distribution differ also from widespread normal distribution, postulated by a central limiting theorem. With symmetrical channel parameter scattering zone tolerance, certain increase of actual mean opening section, in comparison with the opening section, corresponding to the channel parameter nominal values, is detected. The results may be used for solving the problems of flattening the opening section experimental distributions (histograms), and for correction of geometrical overheating factors, when calculating random temperatures variations in a reactor core. 5 refs.; 5 figs.

39745 **(FhG-IWM-V—19/86) Analysis and development of fracture mechanical failure concepts on the basis of research results from the field of component safety engineering. Points of main interest: J-integral concept, crack resistance curves, dynamic parameters. Final report.** Schmitt, W. (Fraunhofer-Institut fuer Werkstoffmechanik, Freiburg im Breisgau (Germany, F.R.)). Jun 1986. 99p. (In German). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88753786/JAW.

On the basis of results and data obtained within the framework of reactor safety research, activities for the development and application of fracture mechanical failure concepts for assessing the behaviour of structural members and components have been carried out in the years 1980 through 1985 in close co-operation with the FhIWM at Freiburg, the IEHK of Aachen University, and the BAM, Berlin. The work performed by the FhIWM are theoretical numerical and experimental investigations centering on the following subjects: Application, verification and development of continuum-mechanical strength and failure concepts on the basis of the J-integral, and analysis of dynamic loads and load characteristics. The results obtained are presented in this report in the three main sections entitled 'Loads', 'Materials characteristics', and 'Applicability'. (orig.) With 62 figs., 3 tabs., 73 refs.

39746 **(FRADOC—14-3) Qualification facilities for safety related electrical equipment.** Raimondo, E. (Societe Franco-Americaine de Constructions Atomiques (FRAMATOME), 92 - Courbevoie (France)). 1986. 5p. (CONF-860603—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88752419/JAW.

From 4. European nuclear conference and 9. FORATOM congress (ENC '86) and international nuclear trade fair; Geneva, Switzerland (1 Jun 1986).

After a recall of the regulations stated in the RCCE (Regles de Construction et de Conception des materiels Electriques), the author describes the KALI Facility used for testing electrical equipment in case of accident in a nuclear power plant.

39747 **(FRADOC—14-5) Ultrafiltration: possible application to the purification of various fluids in nuclear power plants - first test results.** Beslu, P.; Charpin, J.; Brun, C. (Societe Franco-Americaine de Constructions Atomiques (FRAMATOME), 92 - Courbevoie (France)). 1986. 6p. (CONF-861013—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88752416/JAW.

From 4. international conference on water chemistry of nuclear reactor systems; Bournemouth, UK (13 Oct 1986).

Generation and transport of activated corrosion products in the primary coolant of Nuclear Power Plants are cause of radiation fields. Radiation exposure to personnel working for equipment maintenance and repair - especially during shut down - increase the cost of these operations (man rem consumption). It is clear that elimination of corrosion products is of greatest interest and explains why it is subject to so many surveys. FRAMATOME deemed that ultrafiltration was one of the available processes - regarding content and size of particles to be removed - which could be applied to the primary water purification, at the nominal operating conditions, e.g, 155 bar and 300/sup 0/C, approx. To support the aforesaid conditions, CEA and FRAMATOME are developing a specific permeable mineral membrane supported by a porous sintered metal. This membrane has been tested to check its decontamination efficiency.

39748 **(FRADOC—15-1) Bases of regulations and analysis methods for nuclear and industrial pipes in case of seism.** Sollogoub, P. (Societe Franco-Americaine de Constructions Atomiques (FRAMATOME), 92 - Courbevoie (France)). Jan 1986. 12p. (In French). (CONF-860189—). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88752414/JAW.

From 1. national colloquium on paraseismic engineering; Saint-Remy-les-Chevreuse, France (29 Jan 1986).

In a first step, after a brief presentation of individual piping system, the paper shows the regulatory requirements for the seismic analysis of hose system and their origin. Then, some points specific to the seismic analysis of piping are presented. The presentation concludes on evolutions than can be observed in this area.

39749 **(JAERI-M—88-073) Experimental study of mixed convective heat transfer in narrow vertical rectangular channel, 1. With water gap of 18 mm.** Kaminaga, Masanori; Sudo, Yukio; Usui, Tohru; Ikawa, Hiromasa. (Japan Atomic Energy Research Inst., Tokyo). Mar 1988. 42p. (In Japanese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88754133/JAW.

This report describes experimental results and discussions of mixed convective heat transfer experiments which were carried out in order to utilize the experimental data to the thermo-hydraulic

design and the safety analysis of upgraded JRR-3. During some anticipated operational occurrences and accident conditions, which were posturated in the JRR-3 safety assessment, there is a case that core flow decreases from steady-state downward forced convective flow to zero flow and at last becomes upward flow due to the natural convective flow induced between the core and the reactor pool, that is, core flow reversal occurs. During the core flow reversal, the mixed convective heat transfer becomes significant and important because natural convection coexists with forced convection. In this case, mixed heat transfer correlations are need to evaluate heat transfer coefficients. In this study, therefore, the local heat transfer coefficients of narrow vertical rectangular channel were obtained and investigated for laminar to turbulent flow in the viewpoint of both forced convection and natural convection. As the results, the region for mixed convective heat transfer were made clear, and the heat transfer correlations for mixed convection were proposed.

39750 (KFK—4100, pp 4100/18-4100/28) **Investigations of crack growth under thermal fatigue loading.** Bethge, K.; Munz, D.; Stamm, H. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Material- und Festkoerperforschung 4 - Teilinstitut Zuverlaessigkeit/Schadenskunde). Sep 1987. NTIS (US Sales Only), PC A16/MF A01. Order Number DE88754024/JAW.

In Nuclear Safety Project. Annual report 1986.

The results of investigations of crack growth under cyclic thermal fatigue loading are presented. The experiments were performed using the reactor pressure vessel steel 20 Mn Mo Ni 55 and cyclical heating up and cooling down specimens with semi-elliptical surface cracks. By use of the weight function method stress intensity factors for the crack under thermal fatigue loading were calculated and served to predict the crack growth under this loading condition. The prediction is then compared with the experimental result.

39751 (NUREG/CP—0091-Vol.3, pp 37-55) **Progress on qualification testing methodology study of electric cables.** Kawakami, W.; Kusama, Y.; Yagi, T.; Arakawa, K.; Ito, M.; Okada, S.; Yoshikawa, M.; Yoshida, K.; Tamura, N. (Japan Atomic Energy Research Institute, Takasaki). Feb 1988. NTIS, PC A 18 - GPO. Order Number TI88006305/JAW. (CONF-8710111—Vol.3).

From 15. water reactor safety information meeting; Gaithersburg, MD, USA (26 Oct 1987).

Sequential testing methodologies were discussed by examining amount of oxygen consumed in organic materials in simultaneous and sequential environments of heat and irradiation, effects of pre-conditioning methods on degradation of material and test conditions on water sorption of materials in steam/spray environments of simulated LOCA in order to assure the validity of the short term sequential method for qualification of electric wires and cables for nuclear uses. The degradation behavior of various jacketing and insulation materials such as chloro-sulfonated polyethylene, ethylene-propylene rubber, cross-linked polyethylene, chloroprene, and silicone rubber were investigated. From these experimental results, it is concluded that the irradiation conditions such as sequential ordering of irradiation and thermal aging, dose rate and irradiation temperature, and presence of air in the LOCA stream/spray environments are important factors in the qualification testing methodology. 22 figures.

39752 (NUREG/CR—5142) **Ductile to brittle toughness transition characterization of A533B steel.** Joyce, J.A. (David Taylor Research Center, Annapolis, MD (USA)). Jun 1988. 35p. NTIS, PC A03/MF A01 - GPO;1. Order Number TI88012473/JAW.

Central to the understanding of nuclear reactor containment vessel fracture safe design is the development of techniques to characterize and predict the fracture of ductile metals in the upper region of the ductile to brittle toughness transition. This project has utilized the J integral parameter to develop toughness transition information for static and dynamic loading rates throughout the toughness transition for an A533 grade B class 1 containment vessel steel. The J at cleavage (J/sup clv/) is evaluated when cleavage occurs, and the J/sup Ic/ is evaluated when ductile crack extension is present. In many specimens, for both static and dynamic rates, both J/sup Ic/ and J/sup clv/ are evaluated and plotted as a function of test temperature and test rate. A principal conclusion is that if dynamic loading rates are used, very little size dependence seems to be present, though larger specimens produce lower bound results. Close agreement is also shown between dynamic initiation cleavage toughness values and the arrest toughness K/sup {Ia}/ values obtained by NBS (Gaithersburg) dynamic crack arrest tests conducted on large edge cracked plates of this same steel alloy.

39753 **Spatial eigenfunctions, time eigenvalues, and leakage currents of two-region (grooved) neutron moderators.** Carpenter, J.M.; Takeda, Y.F.; Mildner, D.F.R. (Argonne National Lab., Intense Pulsed Neutron Source, 9700 South Cass Avenue, Argonne, IL (US)). *Nuclear Science and Engineering;* **98**: No. 4, 326-340(Apr 1988).

Grooved moderators provide greater neutron leakage currents from their channeled surfaces than flat moderators of the same volume. Operated in conjunction with pulsed sources to provide beams of slow neutrons, their pulse widths depend in a complicated way on the groove parameters, as does the leakage current. A one-speed diffusion theory treatment of the asymmetric grooved moderator is described, the eigenfunctions and eigenvalues are presented, and a simple graphical method for eigenvalue calculation is provided. The leakage from the bottoms of the grooves and from the tips of the fins are separately determined and the lowest order functions for a cold polyethylene moderator are calculated. The results for the lowest order time eigenvalue are in good agreement with a measurement obtained at the Intense Pulsed Neutron Source.

39754 **Experimental verification of calculated neutron streaming in the bottom reflector and core support regions of a large-scale high-temperature gas-cooled reactor design concept.** Slater, C.O.; Muckenthaler, F.J.; Ingersoll, D.T. (Oak Ridge National Lab., P.O. Box X, Bldg. 6025, Oak Ridge, TN (US)). *Nuclear Science and Engineering;* **97**: No. 2, 123-144(Oct 1987).

The analysis of an Oak Ridge National Laboratory Tower Shielding Facility (TSF) experiment in which measurements were made of neutrons streaming through a mockup of a section of the lower core support structure of a large-scale high-temperature gas-cooled reactor (HTGR) design concept is described. The analysis was performed with the same calculational methods used for an analysis of the HTGR design itself, the purpose of the experiment being to provide data against which the validity of the calculational methods could be tested. Also summarized are the HTGR design calculation results; how they affected the design and objectives of the TSF experiment is described. Comparisons of the neutron detector responses observed in the experiment with calculated responses showed satisfactory agreement in most cases, and the implications of these results for the HTGR shield design are highlighted.

39755 **Examination of scaling criteria for nuclear reactor thermal-hydraulic test facilities.** Moskal, T.E. Pittsburgh, PA; Carnegie-Mellon Univ. (1987). 243p. University Microfilms Order No. 87-13,895.

Thesis (Ph. D.).

Scaling criteria for a natural-circulation loop are examined. The present state of knowledge of scaling to obtain similarity during single- and two-phase flow conditions in a closed loop are reviewed, and an alternative development of two-phase similarity parameters is presented. The loop scaling criteria are the results of analyses in which flow from one component to another is considered. In this work, boundary conditions for the closed loop are developed to obtain scaling criteria for leak flow, injection flow, and heat loss to ambient. The leak scaling criteria are specialized for modeling approaches using prototypic fluid at prototypic or reduced pressures. The derived scaling parameters are examined for their application to two existing scaled test facilities: the Multi-Loop Integral System Test (MIST) facility at Babcock & Wilcox, and the UMCP 2 x 4 facility at the University of Maryland College Park. The heat loss similarity analysis is performed in conjunction with reconsideration of piping wall metal mass. It is found that preservation of scaled energy exchange during cooldown transients is possible but impractical. The occurrence of local phenomena such as two-phase flow regime do not enter the loop-scaling analyses reviewed. However, hot leg two-phase flow regime has a pivot-

al role in a natural circulation cooldown transient in a Babock & Wilcox Reactor Coolant System.

39756 **Erosion-corrosion in nuclear power systems - An overview.** Cragnolino, G. Houston, TX; National Assoc. of Corrosion Engineers (1987). 12p. (CONF-870314—). National Assoc. of Corrosion Engineers, P.O. Box 218340, Houston, TX 77218.

From Corrosion '87; San Francisco, CA, USA (9 Mar 1987).

Erosion-corrosion of steels employed in the steam-water cycle of power generating plants is reviewed. Data and observations reported in the literature for carbon, low-alloy and stainless steels in high temperature aqueous systems are discussed, emphasizing the role of hydrodynamic and electrochemical factors in this form of flow-dependent corrosion.

39757 **Comparison of the similarity laws and the system thermal-hydraulic code for scaling applications.** Wang, Z.Y. College Park, MD; Univ. of Maryland (1987). 244p. University Microfilms Order No. 87-25,443.

Thesis (Ph. D.).

This study analyzes the limitations of the similarity laws in reactor thermal-hydraulics and quantifies the cause-and-effect interrelationships of flow phenomena in a two-phase fluid system. To quantify the distortions that inevitably occur during scaling, two terms are defined. The distortion quantified by the first term (Boundary Distortion, BD) is generated when the similarity laws are applied on the basis of a set of discrete dimensionless similarity parameters. It is equivalent to the distortion recognized in current scaling procedures. The other term (System Distortion, SD) is a newly defined term used to quantify the distortions caused by interrelationships' occurring within the flow system. The characteristic trends of the BD's and SD's of a set of similarity parameters are quantified for four scaling approaches (schemes). The similarity parameters are developed on the basis of the two-fluid continuity and momentum equations used in the RELAP5/MOD2 code which is a state-of-the-art one-dimensional systems simulation code. The SD's are calculated by employing the RELAP5/MOD2 code for the vertical hot leg of a Babcock & Wilcox type Pressurized Water Reactor.

2203 Fuel Elements

REFER ALSO TO CITATION(S) 39266, 39680, 39735, 39804, 39967

39758 **(AERE-M—3650) Including clad plasticity within the TRAFIC fuel pin modelling code.** Ford, I.J. (UKAEA Harwell Lab. Theoretical Physics Div.). Feb 1988. 11p. (FPCG/P—88-88). H.M. Stationery Office, London, price Pound 4.00.

A model has been developed to accommodate the plastic deformation of cladding materials within the fuel pin code TRAFIC. Strain-hardening due to an effective plastic strain esub(e)sup(rho) has been included. The numerical implementation of the incremental stress-strain relations is tested with good agreement against two cases where analytical solutions are possible: (a) a power-law stress-strain relation with zero initial yield stress and (b) a case of near-perfect plasticity with a large initial yield stress.

39759 **(IAE—4306/4) Developing new calculational and experimental techniques for studying the WWER reactor cores and characteristics. Analytical method of calculating the stresses and deformations in a fuel element.** Zakharko, Yu.A.; Proshkin, A.A. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1986. 36p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703131/JAW.

Necessity of analytical approaches alongside with existing numerical methods of fuel element calculation is discussed. Analytical solutions of viscoelastic equations describing mechanical fuel-cladding interaction have been obtained. At that universal temperature dependence of creep characteristics is suggested. Dependence of behaviour of the WWER fuel element fuel and cladding on absolute temperature level and gradients is analysed. 6 refs.

39760 (INIS-mf—11097, pp 138-144) **Fuel cycle economics in the Czechoslovak nuclear power situation.** Svec, P. 1986. (In Slovak). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88780069/JAW.

In Collection of the institute's papers 1985.

Some problems are discussed of the fuel cycle economics in the Czechoslovak situation of nuclear power development. The technological operations of the fuel cycle, from uranium mining to the production of fuel elements, are currently reduced to the purchase of the required quantity of fuel elements from the USSR. At an estimated installed capacity of Czechoslovak nuclear power plants in the year 2000 of 10,280 MW, the cost of fresh fuel in 1990 will be 2.2 billion Czechoslovak crowns and in 2000, 7.2 billion. The cost can only be reduced if some production operations which are less demanding on investment and power are introduced in Czechoslovakia. They mainly include the production of UO/sub 2/ pellets, the production of non-uranium components of fuel elements, the assembly of elements from pellets and semifinished Zr products for WWER-440 and WWER-1000 reactors. Briefly characterized are the trends of more efficient utilization of nuclear fuel during its dwell in the reactor through improved burnup, improved neutron economy in the core, etc. (Z.M.). 10 refs.

39761 **(INIS-mf—11736) Development of fuel elements with especially high fuel density for use in research reactors, project 4/1. Final report. Period covered: April 1, 1982 to December 31, 1986.** (Nuklear-Chemie und -Metallurgie G.m.b.H. (NUKEM), Hanau (Germany, F.R.); Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.)). Jul 1987. 24p. (In German). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88754016/JAW.

A production method for U/sub 3/Si/sub 2/ fuel powder was developed ready for industrial application; U/sub 3/Si fuel powders can also be produced bench-scale at limited quantity throughputs. The development of a method involving flame-spraying of fuel patterns provides an effective method for preventing so-called 'white spots' in fuel plates. Irradiation specimen, testing and prototype fuel elements with especially high fuel density were produced and supplied for testing in reactors. A computer-controlled testing method featuring high accuracy and clarity of information was developed for ultrasonic bonding tests on fuel plates. A scrap dissolution equipment suitable for the production line was developed and qualified for recycling manufacturing wastes and for scrap processing.

2204 Control Systems

REFER ALSO TO CITATION(S) 39737, 39953

39762 **(CONF-880506—4) The role of SASSYS-1 in LMR [Liquid Metal Reactor] safety analysis.** Dunn, F.E.; Wei, T.Y.C. (Argonne National Lab., IL (USA)). 1988. Contract W-31109-ENG-38. 31p. NTIS, PC A03;3. Order Number DE88009939/JAW.

From Safety of next generation power reactors; Seattle, WA, USA (1 May 1988).

The SASSYS-1 liquid metal reactor systems analysis computer code is currently being used as the principal tool for analysis of reactor plant transients in LMR development projects. These include the IFR and EBR-II Projects at Argonne National Laboratory, the FFTF project at Westinghouse-Hanford, the PRISM project at General Electric, the SAFR project at Rockwell International, and the LSPB project at EPRI. The SASSYS-1 code features a multiple-channel thermal-hydraulics core representation coupled with a point kinetics neutronics model with reactivity feedback, all combined with detailed one-dimensional thermal-hydraulic models of the primary and intermediate heat transport systems, including pipes, pumps, plena, valves, heat exchangers and steam generators. In addition, SASSYS-1 contains detailed models for active and passive shutdown and emergency heat rejection systems and a generalized plant control system model. With these models, SASSYS-1 provides the capability to analyze a wide range of transients, including normal operational transients, shutdown heat removal transients, and anticipated transients without scram events. 26 refs., 16 figs.

39763 (CONF-880633—2) Operator model-based design and evaluation of advanced systems: Computational models. Schryver, J.C. (Oak Ridge National Lab., TN (USA)). 1988. Contract AC05-84OR21400. 8p. NTIS, PC A02/MF A01;1; GPO Dep. Order Number DE88011377/JAW.

From 4. international conference on human factors and power plants; Monterey, CA, USA (5 Jun 1988).

A multi-level operator modeling effort is recommended to provide broad support for integrated design of advanced control and protection systems for new nuclear power plants (NPP). A computational model is described which accounts for the cognitive activities of the operator by combining the advantages of network simulation and knowledge-based simulation. The integrated Reactor Operator/System (INTEROPS) model is a time-based simulation model which can be coupled with, and control, a thermal-hydraulics model of a nuclear power plant. The INTEROPS model can provide fine-grained evaluation of allocation of functions during the iterative design phase of advanced systems.

39764 (CONF-880633—3) Operator model-based design and evaluation of advanced systems: Conceptual models. Schryver, J.C. (Oak Ridge National Lab., TN (USA)). 1988. Contract AC05-84OR21400. 7p. NTIS, PC A02/MF A01;1; GPO Dep. Order Number DE88011376/JAW.

From 4. international conference on human factors and power plants; Monterey, CA, USA (5 Jun 1988).

A multi-level operator modeling approach is recommended to provide broad support for the integrated design of advanced control and protection systems for new nuclear power plants. Preliminary design should address the symbiosis of automated systems and human operator by giving careful attention to the roles assigned to these two system elements. A conceptual model of the operator role is developed in the context of a command-control-communication problem. According to this approach, joint responsibility can be realized in at least two ways: sharing or allocation. The inherent stabilities of different regions of the operator role space are considered. It is conjectured that the 'supervisor' role may prove to be less effective than an 'equal partner' role, because the latter maximizes the degree of engagement for the operator.

39765 (DOE/NE/37959—14) Signal validation in nuclear power plants: Progress report no. 5. Upadhyaya, B.R.; Kerlin, T.W. (Tennessee Univ., Knoxville (USA)). 1988. Contract AC02-86NE37959. 35p. NTIS, PC A03;3. Order Number DE88008301/JAW.

This report summarizes the progress of the Signal Validation Project during the first quarter of 1988. A database, containing process variables from the Northeast Utilities Services Company's four-loop PWR, has been established. This database is available for evaluating signal validation modules developed under this research project. We have established further contacts at EBR-II for acquiring test data which will be used at the University of Tennessee. A major effort is underway in developing the system executive.

39766 (EPRI-NP—5796) Valve performance in PWR chemical and volume control systems: Final report. Bergmann, C.A.; Lamantia, L.A. (Electric Power Research Inst., Palo Alto, CA (USA)). Jun 1988. 44p. Unlimited audience, publicly available. Research Reports Center, Box 50490, Palo Alto, CA 94303;1. Order Number TI88011936/JAW.

The results of a survey of Westinghouse plants to determine if high cobalt parts are always used in the charging flow control valve located downstream of the charging pump in the Chemical and Volume Control System (CVCS) and a revised cobalt input estimate from all valves in the CVCS system are described in this report. In addition, information gained from retrieval of wear data from the Nuclear Plant Reliability Data System is summarized. It was found that the cobalt input from CVCS system valves could range from 4 to 7 percent of the total annual plant cobalt input depending upon the type of charging flow control valve used.

39767 (EPRI-NP—5819) Computer-assisted design enhancement of a PWR Digital Control System: Final report. Shah, S.C.; Elia, C.F.; Schneider, K.M.; Chang, S.C. (Electric Power Research Inst., Palo Alto, CA (USA)). Jun 1988. 123p. Unlimited audience, publicly available. Research Reports Center, Box 50490, Palo Alto, CA 94303;1. Order Number TI88011931/JAW.

Computer-Aided Control Design tools are used to design advanced digital wide range steam generator level control. Previous work had shown significant improvement in robustness and regulation over conventional controller designs. This work extends the previous effort to move closer to implementation. Plant test data obtained from the participating utility was used to refine and validate the nonlinear mathematical model. The low power steam generator level control was redesigned using the validated model. Feedwater pressure control and feedwater flow control were redesigned to operate over the full range of operation involving transitions -- 1) between the main valve and the bypass valve, 2) between the turbine driven pump and the motor driven pump, as well as, 3) between the low power steam generator level controller and a high power steam generator level controller. The high power level controller was supplied by EPRI. The resulting wide range controller displays significant improvements in performance. The resulting digital control design is converted to real-time code that can be implemented on any control computer. Finally, the engineering effort required using the tools is compared to the effort required without such tools.

39768 (FEI—1695) Measuring and calculational complex on the base of multi-detector system and the kinetics parameters by the method of neutron pulsed source. Veselova, G.P.; Grachev, A.V.; Ivanova, N.K. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk. Fiziko-Ehnergeticheskij Inst.). 1985. 16p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88701564/JAW.

Description of hardware of a measuring and calculation complex (MCC) designed for measuring neutron-physical characteristics of a reactor by the neutron pulsed method simultaneously from 8 detectors and the MERA-60 computer software used by MCC for measuring dependences of neutron generation and life time on the reactivity change is presented. The complex serviceability is tested at one of the PEI physical stands. MCC operation during a year has demonstrated its high reliability and a possibility of being used both for pulsed and other methods for investigating physical stands without introduction of supplementary equipment. 4 refs.; 7 figs.

39769 (INIS-mf—11249) Metrology of physico-chemical variables at nuclear power plants. Brablc, M. (Ceskoslovenska Vedeckotechnicka Spolecnost, Prague. Dum Techniky). 1986. 6p. (In Czech). (CONF-8606407—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88703063/JAW.

From 12. national seminar on measurements in power engineering; Zdar nad Sazavou, Czechoslovakia (9 Jun 1986).

Published in seminar proceedings "Metrologie jadernych elektraren", p. 108-113.

Activities in metrology of physico-chemical variables at the Dukovany nuclear power plant are centred mainly on the testing of measuring instruments from chemical and radiochemical laboratories and of control measuring instruments from the measuring and control unit. They are concieved such that all instruments measuring physico-chemical variables occurring in the operation of the nuclear power plant will be tested. The inspection includes: measurement of pH and conductivity of aqueous solutions, kinematic viscosity and weight. The said procedures are briefly characterized. Also specified is the testing of measuring instruments for gaseous mixtures, air, and measuring instruments operating on the principle of optical methods. (Z.M.).

39770 **(JAERI-M—88-044) Approach to build a knowledge base for reactor accident diagnostic expert system disket.** Aoyagi, Toshihiko; Yoshida, Kazuo; Hirota, Yasuhiro; Fujiki, Kazuo; Kohsaka, Atsuo. (Japan Atomic Energy Research Inst., Tokyo). Mar 1988. 63p. (In Japanese). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88754123/JAW.

In the development of a rule based expert system, one of key issues is how to acquire knowledge and to build knowledge base (KB). On building the KB of DISKET, which is an expert system for nuclear reactor accident diagnosis developed in JAERI, several problems have been experienced as follows. To write rules is a time consuming task, and it is difficult to keep the objectivity and consistency of rules as the number of rules increase. Further, certainty factors (CFs) must be often determined according to engineering judgement, i.e. empirically or intuitively. A systematic approach was attempted to handle these difficulties and to build an objective KB efficiently. The approach described in this report is based on the concept that a prototype KB, colloquially speaking "an initial guess", should first be generated in a systematic way and then is to be modified and/or improved by human experts for practical use. Statistical methods, principally Factor Analysis, were used as the systematic way to build a prototype KB for the DISKET using a PWR plant simulator data. The source information is a number of data obtained from the simulation of transients, such as the status of components and annunciators etc., and major process parameters like pressures, temperatures and so on. The results of diagnoses shows that the statistical method, Factor Analysis, is powerful for building a prototype of knowledge base of an expert system for reactor accident diagnosis like DISKET.

39771 **(Juel-Spez—422) Utilizing foreign operating experience to derive reliability data - especially for common mode failures.** Bongartz, R.; Hennings, W.; Meessen, H. (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Nukleare Sicherheitsforschung). Nov 1987. 189p. (In German). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88753828/JAW.

Update of internal report KFA-ISF-IB--1/85.

Failure rates for common mode failures of redundant components of the same design are derived from abnormal occurrences in safety systems of US nuclear power stations for use on a national level. The available raw data of interest for pumps and valves (processed Licensee Event Reports) are progressively re-evaluated and checked for transferability of German conditions. Most of the common mode failures (CMF) experienced affected only part of the redundancies; the homogeneous Marshall-Olkin model is therefore used to determine failure rates for both partial and total failures of redundant components. Some few results based on zero failure statistics and a small data base (four-train systems) seem to be too conservative. On the whole, however, the application of the data determined here does not provide any unrealistically high system unavailabilities. (orig.)

39772 (NUREG/CP—0091-Vol.5, pp 185-186) **Development and implementation of a BWR digital feedwater control system.** Sun, B.; Hammer, M.; Penland, J.; Popovic, J. (Electric Power Research Institute, Palo Alto, CA (USA)). Feb 1988. NTIS, PC A20/MF A01. Order Number TI88006492/JAW. (CONF-8710111—Vol.5).

From 15. water reactor safety information meeting; Gaithersburg, MD, USA (26 Oct 1987).

EPRI and Northern States Power Company (NSP) realized that fault-tolerant digital technology could improve Feedwater Control System reliability and operations. The Digital Feedwater Control System (DFCS) is the first major fault-tolerant digital control application in a nuclear power plant in the US. The microprocessor-based controller replaced the analog controller in the feedwater control loop to improve performance and reliability of control including ease of maintenance and spare parts supply. The DFCS at Monticello plant has been in operation since July 1986 without any failure of the control system. This system replaced and upgraded the main and start-up analog controllers at Monticello BWR. It features automatic control, on-line signal validation, controller self-diagnosis, and fault tolerance. The dual-redundant hardware configuration minimizes spare parts availability problems. At a control room panel, operators select each feedwater valve's operating mode (one or three element control, manual, and so on) or set bias inputs for individual feed-water-valve demand. These and other features permit more exact feedwater control system tuning, improving feedwater control in all modes of plant operation. Signal validation using parity-space techniques isolated failed sensors and permit system switching to accurate sensors, thus avoiding outages. To ensure successful operation of the system, extensive verification and validation effect were conducted. These included design reviews, factory acceptance testing using simulation code, site acceptance testing using full-scale plant simulator, and pre-operational and operational testing at Monticello plant.

39773 **Multidimensional effects in optimal-control calculations for time-dependent nuclear systems.** Wyss, G.D. Urbana-Champaign, IL; Univ. of Illinois (1987). 204p. University Microfilms Order No. 87-21,788.

Thesis (Ph. D.).

Physically realistic step-function control rod models are shown to be unsolvable under traditional formulations of distributed-parameter optimal-control theory. Extensions to the theory are proposed, and the method of reduced dimensional control is derived to allow systems of this type to be analyzed using generalized optimality conditions. Distributed-parameter optimal control is shown to be a special case of this theory. Reduced dimensional control is shown to be adequate for the analysis of most optimality problems where there are differences in the number of dimensions on which the state variables are defined. The method is then applied to a xenon-iodine oscillation problem in two dimensions. A step-function control-rod model is examined and compared with an axially homogeneous model. The conditions of optimality are found, and analytical insights concerning the importance of the control-rod tip for the optimality condition are obtained. The optimality and normalization conditions are solved numerically for a severe xenon transient. Differences are noted between the cases which can be directly attributed to the proper axial modeling of the control rod.

2205 Environmental Aspects

REFER ALSO TO CITATION(S) 39651, 39683, 39803, 39806, 39855, 39857, 39859, 39950, 39960, 41252, 41623, 41624

39774 **(ASEA-ATOM-UK—86-294) Transient fission gas release model in STAV5.** Massih, A.; Forsberg, K. (ASEA-ATOM AB, Vaesteraas (Sweden); Swedish Nuclear Power Inspectorate, Stockholm). May 1986. 86p. (SKI-B—24-85-3). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88754028/JAW.

The first part reviews the underlying physical mechanisms and their mathematical formulation governing the migration and release of fission product gases in irradiated fuel. On the basis of both experimental and theoretical works it is established that at fuel temperatures 1000 < T < 1650/sup 0/C, the single atom gas diffusion is the dominant release mechanism. At temperatures greater than 1650/sup 0/C it is expected that other mechanisms such as gas bubble motion and coalescence, grain growth, enhanced diffusion in the presence of large temperature gradient etc., can contribute to high fission gas release. STAV5 uses single atom gas diffusion model for the high release prediction. An improved version of this model which removes the restriction in mathematical treatment of the diffusion equation that the gas diffusion coefficient, the re-solution parameter and the gas generation are time independent is outlined in part II. This improved model is implemented in the new ASEA-ATOM fuel performance code STAV6. A detailed parametric sensitivity study and an analysis of a Halden reactor transient test case are also presented. In part III we have tested both STAV5 and STAV6 release models against the release data of some of the Oskarshamn 2 fuel rods. It is observed that STAV6 model is more sensitive to changes in variables such as linear heat rating and maximum pellet densification as a result of which a better agreement with the experimental data is obtained.

39775 **(BMU—1987-163) Monitoring of airborne radionuclide emission from the secondary loop of nuclear power plant equipped with PWR type reactors.** (Bundesministerium fuer Umwelt, Naturschutz und Reaktorsicherheit, Bonn (Germany, F.R.); Technischer Ueberwachungs-Verein Rheinland e.V., Koeln (Germany, F.R.)). 1987. 390p. (In German). GRM Werbeberatung - Werbemittlung -PR, Eggenstein-Leopoldshaften, (Germany, F.R.).

Schriftenreihe Reaktorsicherheit und Strahlenschutz. Ergebnisberichte, Untersuchungen, Studien, Gutachten.

The engineered safety measures for prevention of radioactivity emissions from the water-steam-circuit are explained, and the current practice of radioactivity monitoring and recording is discussed with a view to performance and efficiency. The monitoring equipment detects I-131, aerosols, noble gases, and tritium emissions. The report refers to nuclear power plant with U-tube steam generators (KWU design, convoy type) and to reactor stations with straight-tube steam generators (BBR design, Muelheim-Kaerlich nuclear power station).

39776 **(DOE/SSDP—0031) [Shippingport Station Decommissioning Project]: FY 1987 annual progress report, October 1, 1986-September 30, 1987.** (Westinghouse Hanford Co., Shippingport, PA (USA)). 16 Jun 1988. Contract AC06-76RL01857;AC06-84RL10421. 67p. NTIS, PC A05/MF A01;1; GPO Dep. Order Number DE88012342/JAW.

This report presents progress on the Shippingport Station Decommissioning Project for FY 1987. There are two main topics: Project Management and Decommissioning Project Activities. Changes from technical and managerial concepts developed in the original Decommissioning Plan are presented with the related technical, economic, or schedule considerations. 3 refs., 9 figs., 4 tabs.

39777 **(IKE—8-15) Environmental effects of thermal power plants.** Gerlitzky, M.; Friedrich, R.; Unger, H. (Stuttgart Univ. (Germany, F.R.). Inst. fuer Kernenergetik und Energiesysteme). Feb 1986. 140p. (In German). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88753795/JAW.

Reviewing critically the present literature, the effects of thermal power plants on the environment are studied. At first, the loads of the different power plant types are compiled. With regard to the effects of emission reduction proceedings the pollutant emissions are quantified. The second chapter shows the effects on the ecological factors, which could be caused by the most important emission components of thermal power plants. Where it is possible, relations between immissions respectively depositions and their effects on climate, man, flora, fauna and materials will be given. This shows that many effects depend strongly on the local landscape, climate and use of natural resources. Therefore, it appears efficient to ascertain different load limits. The last chapter gives a suggestion for an ecological compatibility test (ECT) of thermal power plants. In modular form the ECT deals with the emission fields, waste heat, pollution burden of air and water, noise, loss of area and aesthetical aspects. Limits depending on local conditions and use of area will be discussed. (orig.)

39778 **(INIS-BR—944) Radioactivity and the man.** Menegassi, J. (Comissao Nacional de Energia Nuclear de Brasil, Rio de Janeiro). Jul 1986. 12p. (In Portuguese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88701599/JAW.

The existence of radiation in the environment and its implication for the man are discussed. (E.G.).

39779 **(INIS-mf—11252) Metrology problems in monitoring the effluents and environment of a nuclear power plant and the internal irradiation of personnel.** Malatova, I.; Bucina, I. (Ceskoslovenska Vedeckotechnicka Spolecnost, Prague. Dum Techniky). 1986. 13p. (In Czech). (CONF-8606407—). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703066/JAW.

From 12. national seminar on measurements in power engineering; Zdar nad Sazavou, Czechoslovakia (9 Jun 1986).

Published in seminar proceedings "Metrologie jadernych elektraren", p. 129-141.

From the metrological point of view, sensitivity and specificity of balancing measurements are the most important factors in monitoring effluents from nuclear power plants into the air and into water flows. Tabulated are monitoring procedures used for aerosols, iodine, rare gases and water vapours as concerns effluents discharged into the atmosphere and scattered and dissolved wastes and water discharged into water flows. Monitoring of the area surrounding the power plant uses the same methods and has the same problems as monitoring effluents. Semiconductor gamma spectrometry is now being used for determining the activity of radionuclides in environmental samples, biological samples, in the bodies of personnel. A detailed description is presented efficiency of a semiconductor spectrometer calibration. (Z.M.). 4 tabs.

39780 (KFK—4100, pp 4400/1-4400/10) **Investigations on the occurrence and retention of penetrating iodine species in the exhaust air of nuclear power plants.** Reichert, U. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Lab. fuer Aerosolphysik und Filtertechnik 2). Sep 1987. (In German). NTIS (US Sales Only), PC A16/MF A01. Order Number DE88754024/JAW.

In Nuclear Safety Project. Annual report 1986.

The alkyl iodides ethyl iodide, pentyl iodide, octyl iodide and isopropyl iodide were synthesized in unlabelled form. The synthesis as well as the isolation and purification steps were modified to suit the special needs connected with radioactive labelling of these compounds. Investigations on the retention by activated carbon and other sorbents were carried out with ethyl iodide and pentyl iodide at exactly defined conditions (temperatures between 30 and 140/sup 0/C, r.h. between 70 and 95%). The retention profiles obtained with CH/sub 3/-CH/sub 2/xI-131 (ethyl iodide) using activated carbon 207B (KI) are shown.

39781 (KFK—4100, pp 4400/13-4400/34) **Investigation into the behaviour of HEPA filters at high temperature, air humidity, and elevated differential pressure.** Ruedinger, V.; Arnitz, T.; Benesch, R.; Ensinger, U.; Geckle, U.; Ricketts, C.J.; Heil, O. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Lab. fuer Aerosolphysik und Filtertechnik 2; Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Hauptabteilung Kerntechnische Betriebe). Sep 1987. (In German). NTIS (US Sales Only), PC A16/MF A01. Order Number DE88754024/JAW.

In Nuclear Safety Project. Annual report 1986.

Investigations into the response of full-size HEPA filters to extended operation under high humidity airflows were continued with tests of 47 commercial and 13 prototypical filter units. The parameters studied were relative air humidity or liquid moisture content, temperatures between 20 and 80/sup 0/C, filter loading with dust, exposure time, and filter orientation to airflow. In view of complementary investigations with samples of HEPA-filter media, a laboratory test facility was built and put into operation. Based on the establishment of the main failure mechanisms, new prototype filters, incorporating a filter medium reinforced by glass-fiber cloth and a new separator design with modified corrugations, were built and tested.

39782 **(NUREG—1221) Summary, analysis, and response to public comments on proposed amendments to 10 CFR Parts 30, 40, 50, 51, 70, and 72: Decommissioning criteria for nuclear facilities.** (Nuclear Regulatory Commission, Washington, DC (USA). Div. of Engineering). Jun 1988. 601p. NTIS, PC A99 - GPO. Order Number TI88012468/JAW.

On February 11, 1985, the NRC issued for public comment proposed rules on decommissioning of nuclear facilities (50 FR 5600). Comment letters were received from 143 organizations and individuals. This report provides a summary and analysis and response to the public comments received.

39783 **(NUREG/CR—4315-Vol.9-Rev.1) Evaluation of nuclear facility decommissioning projects: Summary status report: Three Mile Island Unit 2 radioactive waste and laundry shipments.** Doerge, D.H.; Haffner, D.R. (Westinghouse Hanford Co., Richland, WA (USA)). Jun 1988. 42p. NTIS, PC A03 - GPO;3. Order Number TI88012472/JAW.

This document summarizes information concerning radioactive waste and laundry shipments from the Three Mile Island Nuclear Station Unit 2 to radioactive waste disposal sites and to protective clothing decontamination facilities (laundries) since the loss of coolant accident experienced on March 28, 1979. Data were collected from radioactive shipment records, summarized, and placed in a computerized data information retrieval/manipulation system which permits extraction of specific information. This report covers the period of April 9, 1979 through April 19, 1987. Included in this report are: waste disposal site locations, dose rates, curie content, waste description, container type and number, volumes and weights. This information is presented in two major categories: protective clothing (laundry) and radioactive waste. Each of the waste shipment reports is in chronological order.

39784 **(NUREG/CR—5106) User's guide for the TACT5 computer code.** West, D.B.; Gilpin, H.E. (Science Applications International Corp., McLean, VA (USA)). Jun 1988. 205p. (SAIC—88/3023). NTIS, PC A10/MF A01 - GPO. Order Number TI88012469/JAW.

The TACT5 computer code, a successor to TACT III and earlier versions of TACT (an acronym for Transport of ACTivity), simulates the movement of radioactivity hypothetically released from a reactor core as it migrates through user-defined regions (nodes) of the containment, is immobilized by filters and sprays, and is released to the outside environment. The code has been modified to run on a personal computer (PC). The original PC version of TACT5 was developed and provided by Larry Bell of the NRC. A series of interactive BASIC preprocessor codes assists the user in compiling a nuclide input data file and a plant model data file. The plant model data file specifies a dynamic compartment model, which is represented by systems of ordinary differential equations with constant coefficients. The equations are solved explicitly by matrix transformation methods. A code run carries out the integration of these systems of equations over a succession of time intervals following reactor shutdown, with the interval boundaries corresponding to transitions of system parameter values which must be constant within eact time interval. Outputs are shown for the end of each time interval and include the level of radioactivity in each node of the containment and in the environment, broken into isotopic groups that may be halogens, noble gases, sodium isotopes, solids, or plutonium isotopes. These categories may optionally be further subdivided into elemental, organic, and particulate forms. Radiation doses to reference individuals at the exclusion radius, the boundary of the low population zone, and, if selected, at a third receptor point, are generated by the code. Values of input parameters also are printed, and a summary is available at the user's option.

39785 **(PB—88-150297/XAB) Environmental radionuclide concentrations in the vicinity of the Calvert Cliffs Nuclear Power Plant: 1978-1980.** McLean, R.I.; Magette, T.E.; Zobel, S.G. (Maryland Power Plant Research Program, Annapolis (USA)). Dec 1982. 50p. (PPSP-R—4). NTIS, PC A03/MF A01.

See also report for 1981-1984, PB—87-227872.

The Power Plant Siting Program conducts radiological analyses of environmental samples collected in the vicinity of the Calvert Cliffs Nuclear Power Plant to determine radioecological impact. The assessment, initiated in 1975, focuses on the ecology of the Chesapeake Bay because aqueous releases represent the greatest radioecological impact pathway. Collections of sediment, finfish, shellfish, miscellaneous invertebrates, algae, and waterfowl were analyzed by high-resolution gamma spectroscopy to determine gamma-emitting radionuclide concentrations. Analysis results and interpretation of studies conducted during 1978-1980 are presented.

39786 **(PB—88-192521/XAB) Environmental radionuclide concentrations in the vicinity of the Peach Bottom Atomic Power Plant: 1981-1984.** McLean, R.L.; Domotor, S.L. (Maryland Power Plant Research Program, Annapolis (USA)). Mar 1988. 59p. (PPRP-R—9). NTIS, PC A04/MF A01.

See also PB—84-240175.

Since 1979, the Power Plant Research Program (PPRP) has conducted radiological monitoring and research in the vicinity of the Peach Bottom Atomic Power Station (PBAPS) to determine the environmental distribution and ecosystem impact of radioactivity released to the Susquehanna River by the plant. During 1981-1984, the subject period of the report, aqueous discharges by PBAPS produced low levels of Zn-65, Cs-134, and Cs-137 in biota of the lower Susquehanna River. Radionuclide concentrations were highest in the vicinity of the plant discharge in the Conowingo Pond. Finfish collected from the Conowingo Dam Tailrace also contained detectable levels of PBAPS-related radionuclides. These radionuclides, as well as Co-60 were also detected in sediments collected from the Conowingo Pond, the lower Susquehanna River, and the upper Chesapeake Bay. Concentrations in sediments were highest in the Conowingo Pond, along the western shore downstream of the plant discharge.

39787 **(PER—162) Environmental radioactivity at the National Nuclear Research Centre, Pelindaba: report for the year 1986.** Bain, C.A.R.; Annandale, J.; Moolman, E.W. (Atomic Energy Corp. of South Africa (Pty) Ltd., Pretoria). Oct 1987. 39p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702832/JAW.

The revised environmental survey programme, introduced during 1970, with the emphasis on monitoring of the critical paths of exposure of the general public, was continued in 1986. Results of determinations of both gross radioactivity and individual nuclides in samples of fish and water (which are critical materials for liquid-effluent releases) from the Hartbeespoort Dam and from the Crocodile River are given and discussed. Results of /sup 131/I, /sup 90/Sr and gamma-spectrometric analyses of milk, the critical material for releases to the atmosphere, are presented. Results are given of regular investigations of the composition of airborne releases to the atmosphere and liquid-effluent releases to the Crocodile River, performed in order to detect other possible critical nuclides. Levels of deposited and airborne activity from nuclear-bomb tests are reported. In addition, special efforts were made to detect radionuclides from the Chernobyl nuclear accident in Russia but to no avail. Owing to absence of fresh fallout material the levels for most fission products have fallen below the limit of detection. No environmental radioactivity due to releases from the Pelindaba site could be detected above the natural background or accumulated fallout levels. Unplanned releases of UF/sub 6/ sometimes occur. Accordingly, some of the environmental samples were also analysed for uranium. The results obtained so far do not indicate an increase in uranium levels in the environment.

39788 **(SSI—87-08) Gamma monitoring stations - annual reports 1985-1986.** Kjelle, P.E. (National Inst. of Radiation Protection, Stockholm (Sweden)). 2 Mar 1987. 74p. NTIS (US Sales Only), PC A04/MF A01. Order Number DE88752722/JAW.

Translated from Swedish: Maetstationer foer gammastraalning - aarsrapport 1985-1986 (SSI--87-03).

The fallout from Chernobyl recorded by this Institute's fixed gamma monitoring stations. Measurement results from 1985 and 1986 in nSv/hr.

2206 Research, Test, And Experimental Reactors

REFER ALSO TO CITATION(S) 39739, 39761, 39847, 39957, 41059, 42424

39789 **(CONF-880748—1) An embrittlement rate effect deduced from HFIR [High Flux Isotope Reactor] that may impact LWR [light water reactor] vessel support life expectancy.** Cheverton, R.D.; Kam, F.B.; Nanstad, R.K.; Robinson, G.C. (Oak Ridge National Lab., TN (USA)). 1988. Contract AC05-84OR21400. 14p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88008686/JAW.

From American Nuclear Society topical meeting on nuclear power plant life extension; Snowbird, UT, USA (31 Jul 1988).

Data from the HFIR pressure vessel surveillance program indicate an embrittlement rate effect that may have a significant impact on the life expectancy of some PWR vessel supports. However, the necessity for extensive extrapolation of the HFIR data and the correlation of data with neutron energies only above 0.1 MeV introduce substantial uncertainties. Furthermore, it is premature to state what the effect of embrittlement is on the life expectancy of the vessel supports. There is, however, sufficient evidence

of an embrittlement rate effect to justify a continuing effort to obtain more definitive answers.

39790 **(EGG-M—88079) Development of a full scope reactor engineering simulator.** Venhuizen, J.R.; Laats, E.T. (EG and G Idaho, Inc., Idaho Falls (USA)). 1988. Contract AC07-76ID01570. 5p. (CONF-880733—2). NTIS, PC A02/MF A01;1; GPO Dep. Order Number DE88007700/JAW.

From Summer computer simulation conference; Seattle, WA, USA (25 Jul 1988).

The Idaho National Engineering Laboratory (INEL) is pursuing the development of an engineering simulator for use by several agencies of the U.S. Government. This simulator, which is part of the INEL Engineering Simulation Center, will provide the highest fidelity simulation with initial objectives for studying augmented nuclear reactor operator training, and later for advanced concepts testing as applicable to control room accident diagnosis and management. The simulator is being built for the Advanced Test Reactor (ATR) located at the INEL. The ATR is a 250 megawatt light water nuclear reactor designed to study the effects of intense radiation on samples of reactor materials. A modernization of the reactor control room (RCR) is underway for enhancing reliable and efficient operation of the reactor for the next 20 years. A new simulator facility has been constructed for the RCR to support operator training requirements. This simulator, completed in April 1988, will undergo a major upgrade by replacing the simplified core physics and fluid dynamics models with the widely used RELAP5 simulation code. When completed, the RELAP5 code will operate on a CRAY X-MP/24 computer and communicate with the ATR Simulator which is some 50 miles away. This high fidelity engineering simulator will then be used to train operators to recognize and respond to severe accident scenarios, a feature never before possible with previous simulators. This unique combination of the new simulator, communications and computing hardware demonstrates a major product of the INEL Engineering Simulation Center.

39791 **(ITEF—166(1986)) Substantiation of the TVR-M reactor parameter selection and specific features of the research program.** Abov, Yu.G.; Kiselev, G.V.; Shvedov, O.V. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1986. 16p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88701641/JAW.

Comparative analysis of characteristics of the T-VR-M(ITEP, USSR), GRHF(France) and PIK(LNPI USSR) high-flux heavy water cooled and moderated research reactors is given. The TVR-M reactor design concepts are mainly based on a 35-year experience in operating of the first Soviet heavy water research TVR reactor. As a result of the reactor reconstruction its thermal power will increase up to 25 MW neutron flux in experimental channels will increase 10 fold and reach 5.6x10/sup 14/ neutron/cm/sup 2/xc. The TVR-M reactor has the quality value the ratio of maximum thermal neutron flux value the reflector to reactor power in practically the same as for the GRHF reactor (2.24x10/sup 13/ (neutron/cm/sup 2/xc)/MW) which allows one to place it among the best research reactors in the world. Maximum fuel burnup of the order of 50% and minimum fuel loading are forseen for the TVR-M reactor which provides for operation cost minimum as compared to the GRHF and PIK reactors. The TVR-M reactor practically does not yield to the PIK and GRMF reactors in experimental channel quantity and exceeds the in the number of vertical channels. The TVR-M reactor experimental capabilities allow one to reduce measuring time and provide for conducting the experiments at a qualitatively new level. At the same time capabilities of radioactive nuclide production in qualitative and quantitative senses are increased. 6 refs.; 4 figs.

39792 **(JAERI-M—88-001) Accident analysis of flow blockage to coolant channels of upgraded JRR-3, using EUREKA-2 code, (1).** Kaminaga, Masanori; Murayama, Youji; Ohnishi, Nobuaki. (Japan Atomic Energy Research Inst., Tokyo). Jan 1988. 40p. (In Japanese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88753621/JAW.

This report describes the results about thermo-hydraulic behavior in the accident of flow blockage to coolant channels of upgraded JRR-3. Analysis was carried out using EUREKA-2 code. Flow blockage to coolant channels accident occur by some extraneous things which come from outside of the reactor pool, may block the coolant flow channels of the core. If flow blockage to coolant channels would occur, fuel temperature will increase due to flow rate decrease of coolant channels. And at last, fission products will be released from inside of fuel plates to the primary cooling system due to failure of fuel plates. In the analysis, one standard type fuel element was supposed as flow blockage channels, in the same way sa one of credible accidents, which postulated in the JRR-3 safety assessment. From the results, it was shown that about 16.7 % of the fuel element which was supposed as flow blockage channels, would fail, assuming that fuel plates might fail when the fuel meat temperatures riseover 400 deg C.

39793 **(KURRI-TR—292) Summary reports of activities under visiting research program in Research Reactor Institute, Kyoto University, in second half of fiscal year 1986.** (Kyoto Univ., Kumatori, Osaka (Japan). Research Reactor Inst.). Jun 1987. 98p. (In Japanese). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88754137/JAW.

This report is published as occasion demands by summarizing the results of the functional test of various experimental facilities, the results of the test of articles made for trial, the state of radiation control and waste treatment, the data required at the time of research and experiment such as the reports at study meetings, the remarkable results and new methods obtained amid research, the discussion on other papers and reports and so on in the form of prompt report. In this report, the title, the names of reporters and the summary of research of each of 77 visiting research projects at the KUR and 8 visiting research projects at the KUCA are reported. (Kako, I.).

39794 **Spatial kinetics studies in liquid-metal fast breeder reactor critical assemblies.** Brumback, S.B.; Goin, R.W.; Carpenter, S.G. (Argonne National Lab., P.O. Box 2528, Idaho Falls, ID (US)). *Nuclear Science and Engineering;* 98: No. 2, 103-117(Feb 1988).

Recent measurements in the zero-power physics reactor have been used to study the effect of spatial decoupling in fast reactor critical assemblies of various sizes and compositions. Flux distributions in these assemblies had varying degrees of sensitivity to perturbations. Decoupling was investigated using rod-drop, boron-oscillator, and noise-coherence techniques, which emphasized different times following perturbations. Equilibrium flux distributions were also measured for subcritical configurations with inserted control rods. For most assemblies, accurate reactivity measurements were obtained by analyzing the power history from a single detector using inverse kinetics methods, assuming an instantaneous efficiency change for the detector. The instantaneous efficiency change assumption broke down, however, in assemblies with zones in which normal plutonium fuel was replaced by /sup 235/U fuel or fuel with a high /sup 240/Pu content. Flux redistributions caused by perturbations in these cores took several minutes to evolve.

2207 Plutonium And Isotope Production Reactors

REFER ALSO TO CITATION(S) 40603

39795 **(CONF-880613—11) Isotopically alloyed injector foils for helium effects research in mixed-spectrum reactors.** Mansur, L.K.; Coghlan, W.A. (Oak Ridge National Lab., TN (USA); Arizona State Univ., Tempe (USA)). 1988. Contract AC05-84OR21400. 14p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88010143/JAW.

From 14. international symposium on effects of radiation on materials; Andover, MA, USA (27 Jun 1988).

A novel technique is described for injecting helium into materials of arbitrary type and composition during mixed-spectrum reactor irradiations. This method is a variation of the isototype alloying technique developed recently, wherein nickel is required as an alloy constituent in the specimens of interest. In the present method no nickel is added to the specimens, so that no changes are introduced in the physical metallurgy. The specimens are interposed between injector foils containing nickel. Helium is generated as α-par-

ticles of energy 4.7 MeV in the two-step reaction $^{58}Ni(n,\gamma)^{59}Ni(n,\alpha)^{56}Fe$ within the injector foils. A fraction of the helium is injected directly into the adjacent specimens to depth of tens of micrometers for typical structural materials. Both the nickel content of the foils and the relative abundances of the isotopes of nickel can be varied to control the helium injection rate over a very wide range, covering helium concentrations of interest in basic studies and technological applications. Mathematical expressions to describe both helium buildup with dose and helium spatial profiles are presented. Results are shown for sample calculations applicable to the quantitative design of experiments in aluminum, copper and vanadium.

39796 (DOE/S—0064) Assessment of candidate reactor technologies for the new production reactor. (USDOE Office of Energy Research, Washington, DC. Energy Research Advisory Board). Jul 1988. 68p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE88013165/JAW.

The Energy Research Advisory Board (ERAB) has reviewed and assessed reactor technologies as candidates for new reactor capacity to produce tritium (and possibly plutonium) to meet US requirements for nuclear weapons materials. In its assessment, the Board emphasized the equal and primary importance of producing goal quantities of tritium when needed and doing so in a safe and environmentally sound manner. Particular strengths and weaknesses of each technology were evaluated in six areas (Technology Base, Safety and Environmental, Schedule, Costs, Industrial Base, and Institutional Acceptance). The ERAB evaluation has found that Heavy Water Reactor technology is the most mature technology for tritium production at the present time. Each of the technologies considered could meet the mission requirements for new production capacity with varying degrees of risk as to cost and schedule. The Board found that, with early planning, there is an opportunity to gain revenues to offset costs by the sale of steam at the site boundary for power production. Safety is a primary consideration in the design, construction, and operation of the new reactor capacity and is of major importance to the technology selection. The Board believes that the design should take full advantage of the results of safety research to date, and that proposed safety goals and a sound safety review process will provide a level of safety that is at least equivalent to that of the best of current commercial power plants.

39797 (INIS-BR—1071) Study of the mechanisms for the emergency cooling of the core of the Radioisotope Producing Reator (RPR). Lacerda, F.C. (Minas Gerais Univ., Belo Horizonte (Brazil). Curso de Pos-graduacao em Ciencias e Tecnicas Nucleares). 1987. 179p. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88702769/JAW.

The mechanisms for the emergency cooling of the core of the Radioisotope Producing Reactor (R.P.R.) are studied, in particular the thermal-hydraulic behaviour of the coolant after reactor shut-down. The coolant operates bd convection, and flows downward through the core passing into beel-shaped plenum that encloses the core and proceeding across the primary cooling loop. When the reactor is shut-down, the coolant flow undergoes a transient period until the steady state of natural convection is reached, after which the coolant flows upwards from the lower plenum. A plocking valve will be installed at the exit of the lower plenum, which will automatically shut in case of an accident that will involve the loss of flow in the primary circuit. The present work aims at evaluating the contribution of natural convection by natural recirculation in the core when the blocking valve is close, and via the external coolant circuit when the blocking valve is open. In particular, we study the natural self-regulating mechanisms of extraction of the heat generated by the fission product after reactor shut-down.

39798 (NUCLEBRAS-CDTN—533) Utilization of the IPR-R1 as a tool in the evaluation of the Brazilian uranium reserves. Stasiulevicius, R. (Centro de Desenvolvimento da Tecnologia Nuclear, Belo Horizonte (Brazil)). 1986. 15p. (In Portuguese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88701697/JAW.

The Brazilian uranium ore resources reach an amount of 301,490 metric tons of U/sub 3/O/sub 8/, twenty-seven times more than the known value when NUCLEBRAS was founded, at the end of 1974. In evaluating this reserve, the IPR-R1 research nuclear reactor has given a significant contribution. This reactor has been in operation since 1960 for research, technology, radionuclide production and training purposes. The available irradiation facilities allow the use of neutron-activation to determine uranium contents. Up to now, a total of 330,000 mineral sample analyses were carried out.

2208 Propulsion Reactors

REFER ALSO TO CITATION(S) 39838, 39839, 39840, 39841, 39842, 39843, 39844

39799 (JAERI-M—88-052) Evaluation of the trial design studies for an advanced marine reactor, (4). Specific characteristics of steam generator. Ambo, Noriaki; Kusunoki, Tsuyoshi; Yokomura, Takeyoshi. (Japan Atomic Energy Research Inst., Tokyo). Mar 1988. 137p. (In Japanese). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88754126/JAW.

As for the Steam Generators of the three type reactor (Semi-Integrated type, Integrated type and Self-pressurized Integrated type) of the trial design studies for an Advanced Marine Reactor, their structure, thermal hydraulics, inspection and maintenance and dynamic analyses were reviewed, and their total specific characteristics were compared and evaluated. Each Steam Generator was same as for its specific characteristics, and available as the Steam Generator for an Advanced Marine Reactor, however it needed to establish an actual proof by experiments.

39800 (JAERI-M—88-054) Evaluation of the trial design studies for an advanced marine reactor, (6). Kinetics. Kusunoki, Tsuyoshi; Yokomura, Takeyoshi. (Japan Atomic Energy Research Inst., Tokyo). Mar 1988. 71p. (In Japanese). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88753638/JAW.

JAERI carried out the three reactors (Semi-integrated type, Integrated type, Self-pressurized Integrated type) as the trial designs of advanced marine reactor for three years (1983 ~ 1985). This report presents the comparison and the evaluation of the trial designs regarding kinetic analysis. As the results, Semi-Integrated type is practical use and useful, Integrated type has possibility of high performance reactor plant, and Self-pressurized Integrated type has simple system.

39801 (JAERI-M—88-057) Evaluation of the trial studies for a advanced marine reactor, (8). Economics. Itoh, Yasuyoshi; Imamura, Yoshiaki; Ambo, Noriaki; Yokomura, Takeyoshi. (Japan Atomic Energy Research Inst., Tokyo). Mar 1988. 69p. (In Japanese). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88754127/JAW.

JAERI carried out the trial design of three type reactors (semi-integrated type, integrated type, and self pressurized integrated type) in order to clarity reactor type of advanced marine reactor for the best practical use in future and to extract its research and development theme. This report presents the comparison and estimation of these three type reactors from economical view point. Economical comparison carried out with next items for estimating the operating cost of ships powered by these three type reactors. (1) cost of reactor plants. (2) cost of fuel processing. (3) fuel cycle cost. As a result, it is cleared that the operating cost is the lowest in the ship powered by the integrated type reactor.

2209 Reactor Safety

REFER ALSO TO CITATION(S) 39642, 39683, 39719, 39720, 39745, 39746, 39755, 39796, 40285, 40708, 41259, 41561, 42082

39802 (CEA-DAS—380) Uncertainty assessment in the seismic response of the primary circuit of a 1300 MWe PWR. Gauvain, J.; Culambourg J. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. d'Analyse de Surete). Sep 1987. 9p. (CONF-870812—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88752406/JAW.

From 9. SMIRT: international conference on structural mechanics in reactor technology; Lausanne, Switzerland (17 Aug 1987).

This paper presents the final results of a five-years research program (1981-1986) realized at the CEA in the Department of mechanical and thermal studies, on the request of the Institute of nuclear protection and safety (IPSN). This research concerns the assessment of the uncertainty in the seismic calculation of the primary circuit of a French 1,300 MWe PWR. In a first step, after the collection of documents, the model of the reactor building and the primary circuit has been done. In a second step the 3D seismic analysis of the reactor building has been performed (already presented, SMIRT 1985 paper K 8/3) and a set of five 3D seismic analysis of the primary circuit, coupled or uncoupled, using the floor response spectra obtained for the building, has been realized. Then in a third step, which is the main purpose of this presentation, a new basic model of the primary circuit has been achieved with five variations in boundary condition hypothesis, and, for each one, six different seismic analysises. As no significant differences for the floor spectra were found in step 2, between coupled and uncoupled calculations, the step 3 has been performed fully uncoupled. The basic method used for these seismic analysises is modal recombination.

39803 (CEA-R—11154) Comparison of European computer codes relative to the aerosol behavior in PWR containment buildings during severe core damage accidents. Fermandjian, J. (Commission of the European Communities, Luxembourg). 1987. 97p. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88752452/JAW.

The prediction of the behavior of nuclear aerosols, associated with postulated PWR accidents, in the reactor containment building, is necessary for the assessment of radiological consequences, and hence it is an important aspect of reactor safety evaluation. The present study concerns a comparative exercise, performed within the framework of the Commission of the European Communities - Division of Safety of Nuclear Installations -, of the computer code (AEROSIM-M, UK; AEROSOLS/B1, France; CORRAL-2, CEC and NAUA Mod5, Germany) used in order to assess the aerosol behavior in PWR containment buildings during severe core damage accidents (with steam condensation onto the particles). The previous CEC aerosol code comparison exercise performed in 1984 within the framework of LMFBR safety, without steam condensation onto the particles, indicated that the results of discrete codes were very similar. The present study shows that the accounting for the steam condensation onto the particles does not lead to large discrepancies concerning the (integrated) aerosol leaked mass despite the differences in the kinetics of aerosol behavior. The large discrepancies between the results of the discrete codes and of the empirical approach code CORRAL-2, especially concerning the instantaneous and integrated leaked masses, justify the development of discrete aerosol behavor codes.

39804 (CONF-880506—6) Techniques of metal fuel transient testing in TREAT [Transient Reactor Test]. Wright, A.E.; Bauer, T.H.; Robinson, W.R.; Klickman, A.E. (Argonne National Lab., IL (USA)). 1988. Contract W-31109-ENG-38. 16p. NTIS, PC A03/MF A01; GPO Dep. Order Number DE88009940/JAW.

From Safety of next generation power reactors; Seattle, WA, USA (1 May 1988).

The thermomechanical response of metal-alloy reactor fuel during reactor overpower accident simulations differs substantially from that of oxide fuel pins. Performance of in-reactor safety tests in TREAT within the Integral Fast Reactor program has required the development of new testing methods and designs to provide needed data on metal fuel behavior for IFR safety assessments. Simplicities resulting from the high fuel thermal conductivity were important in achieving the more-difficult objectives of these tests. 3 refs., 1 fig.

39805 (CONF-880506—11) Inherent safety and operability testing in EBR-II. Sackett, J.I.; Planchon, H.P.; Lehto, W.K.; Golden, G.H. (Argonne National Lab., IL (USA)). 1988. Contract W-31109-ENG-38. 24p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88010013/JAW.

From Safety of next generation power reactors; Seattle, WA, USA (1 May 1988).

EBR-II is being used to develop advanced safety and operating strategies for next-generation LMR power plants. The work is divided into five categories: (1) control strategy and plant testing; (2) computer simulation; (3) diagnostics; (4) plant automation; and (5) computer reliability. A major milestone in the EBR-II program was the conduct of the Inherent Safety Demonstration Tests in April 1986. Since then, work has been undertaken on advanced control strategies that are compatible with inherent safety characteristics of metal-fueled LMRs and which also preclude damaging transient overpower events. Six plant tests were conducted in November 1987 to investigate plant maneuverability without control rod action. These tests also provided an opportunity for testing two important diagnostic and display systems. These systems will lay the basis for future automation of EBR-II and follow-on plants.

39806 (CONF-880604—10) Chemical considerations in severe accident analysis. Malinauskas, A.P.; Kress, T.S. (Oak Ridge National Lab., TN (USA)). 1988. Contract AC05-84OR21400. 20p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88011374/JAW.

From Joint meeting of the 195th national meeting of the American Chemical Society and the 3rd Chemical Congress of North America; Toronto, Canada (5 Jun 1988).

The Reactor Safety Study presented the first systematic attempt to include fission product physicochemical effects in the determination of expected consequences of hypothetical nuclear reactor power plant accidents. At the time, however, the data base was sparse, and the treatment of fission product behavior was not entirely consistent or accurate. Considerable research has since been performed to identify and understand chemical phenomena that can occur in the course of a nuclear reactor accident, and how these phenomena affect fission product behavior. In this report, the current status of our understanding of the chemistry of fission products in severe core damage accidents is summarized and contrasted with that of the Reactor Safety Study.

39807 (CONF-880733—3) On-line modeling tutorials for emergency managers. Newsom, D.E. (Argonne National Lab., IL (USA)). 1988. Contract W-31109-ENG-38. 5p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88009988/JAW.

From Summer computer simulation conference; Seattle, WA, USA (25 Jul 1988).

The Federal Emergency Management Agency (FEMA) maintains two simulation models of interest to Federal, State, and local government managers: MESORAD, a model of radiological plume dispersion and dose; and IDYNEV, a model of traffic movement during evacuation. Users of these models include government staff and technical consultants with simulation experience ranging from extensive to none. To train these users, Argonne National Laboraory has developed two on-line tutorials. The tutorials provide a self-paced, interactive mode of learning about the models. Though user manuals about the models exist, the tutorials afford self-contained instruction to users who lack access to the manuals. The tutorials describe: dose assessment and transportation analysis using computer models; the input parameters needed by the models; how to use forms management software to prepare the data; and how to run the models and view outputs. The tutorials have evolved with upgrades to the models, including the need at various times to emulate three different forms management packages. The tutorials have been used for individual study; in continuing education courses at FEMA's Emergency Management Institute; and are being considered for college classroom use. Persons trained in using the models

have applied them to actual emergency planning problems for nuclear power plants. 4 refs., 3 figs., 2 tabs.

39808 **(EPRI-NP—5652) Guideline for the utilization of commercial grade items in nuclear safety related applications: Final report.** Tulay, M.P.; Yurich, F.J.; Schremser, F.M. Jr. (Electric Power Research Inst., Palo Alto, CA (USA); Gilbert/Commonwealth, Inc., Reading, PA (USA)). Jun 1988. 104p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88012513/JAW.

This guideline provides direction for the procurement and use of Commercial Grade Items (CGI)in safety-related applications. It is divided into five major sections. A glossary of terms and definitions, an acronym listing, and seven appendices have been included. The glossary defines terms used in this guideline. In certain instances, the definitions may be unique to this guideline. Identification of acronyms utilized in this guideline is also provided. Section 1 provides a background of the commercial grade item issues facing the nuclear industry. It provides a historical perspective of commercial grade item issues. Section 2 discusses the generic process for the acceptance of a commercial grade item for safety-related use. Section 3 defines the four distinct methods used to accept commercial grade items for safety-related applications. Section 4 lists specific references that are identified in this guideline. Section 5 is a bibliography of documents that were considered in developed this guideline, but were not directly referenced in the document.

39809 **(EPRI-NP—5781-SR) Proceedings: Fifth international RETRAN conference.** Agee, L.J. (ed.). (Electric Power Research Inst., Palo Alto, CA (USA)). Apr 1988. 827p. (CONF-8711152—). Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88010466/JAW.

From 5. international RETRAN meeting; Boston, MA, USA (9 Nov 1987).

Separate abstracts were prepared for the individual papers in this report.

39810 (EUR—11019, pp 11-42) **Insights gained through probabilistic risk assessments.** Hitchler, M.J.; Burns, N.L.; Liparulo, N.J.; Mink, F.J. (Westinghouse Electric Corp., Pittsburgh, PA (US); Westinghouse Electric Nuclear Energy Systems Europe (Wenese), Brussels (BE)). 1987. NTIS (US Sales Only), PC A13/MF A01. Order Number DE88780090/JAW. (CONF-8611215—).

From Seminar concerning safety studies on severe accident in light water reactors; Brussels, Belgium (10 Nov 1986).

The insights gained through a comparison of seven probabilistic risk assessments (PRA) studies (Italian PUN, Sizewell B, Ringhals 2, Millstone 3, Zion 1 and 2, Oconee 3, and Seabrook) included insights regarding the adequacy of the PRA technology utilized in the studies and the potential areas for improvement and insights regarding the adequacy of plant designs and how PRA has been utilized to enhance the design and operation of nuclear power plants.

39811 (EUR—11019, pp 43-58) **Studies of severe accidents in light water reactors. Containment performance.** Hayns, M.R.; Phillips, D.W.; Young, R.L.D. (UKAEA National Centre of Systems Reliability, Culcheth). 1987. NTIS (US Sales Only), PC A13/MF A01. Order Number DE88780090/JAW. (CONF-8611215—).

From Seminar concerning safety studies on severe accident in light water reactors; Brussels, Belgium (10 Nov 1986).

The containment system of a LWR is an obvious component of the plant which performs an important safety function in preventing the release of fission products to the environment in the event of design basis accidents. With over 260 LWRs in service worldwide, and others still under construction, there is a considerable diversity of containment types and combinations of containment safeguards systems. All of these satisfy local regulatory requirements which are principally aimed at the design basis accidents, and these requirements naturally have a considerable uniformity. However, their design diversity becomes more relevant to the performance of the containment in severe accident conditions, and this aspect of containment performance is reviewed in this paper. The ability of the containment to mitigate severe accident consequences introduces the potential for accident management and recovery and this in turn points towards a range of new containment systems and concepts. PSA helps in judging these possibilities and in forming policies and procedures for accident management. It is perhaps in accident management that severe accident containment performance will be most beneficial in the future, and where additional effort in containment analysis will be focused.

39812 (EUR—11019, pp 59-82) **Main results of the German risk study - phase B.** Heuser, F.W. (Gesellschaft fuer Reaktorsicherheit (GRS), Koeln (DE)). 1987. NTIS (US Sales Only), PC A13/MF A01. Order Number DE88780090/JAW. (CONF-8611215—).

From Seminar concerning safety studies on severe accident in light water reactors; Brussels, Belgium (10 Nov 1986).

To start the author introduces briefly some comments on main tasks and objectives of risk analysises which at least after the Chernobyl accident should be emphasized more explicitly. Following on some main results of the system - and accident event tree analysis of the German Risk Study, Phase B, are summarized. The second part of this paper deals with the analysis of core melt accidents performed in context of the study. Hetero investigations on the hydrogen problem and investigations on containment venting after a core melt accident will be discussed in more detail.

39813 (EUR—11019, pp 85-108) **Swedish programme for mitigation of core melt consequences.** Bystedt, P. (Swedish Nuclear Power Inspectorate, Stockholm). 1987. NTIS (US Sales Only), PC A13/MF A01. Order Number DE88780090/JAW. (CONF-8611215—).

From Seminar concerning safety studies on severe accident in light water reactors; Brussels, Belgium (10 Nov 1986).

In 1980-81, on account of the TMI accident, the Swedish Government decided on a program for improved protection against releases of radioactivity in case of a severe accident. Clearly, prevention of core damage has been retained as a first priority. However, it was recognized that the probability of core damage, although small, is not zero. Accordingly, safety measures aimed at mitigating the consequences of severe accidents were required, even when costs for the utilities might be considerable. A primary objective was to reduce releases of substances such as iodine and cesium which contribute to long term ground contamination. The Barsebeck twin BWR power station, sited fairly close to densely populated areas in southern Sweden and in Denmark was given priority in the program. The concept adopted for Barsebeck was the so called FILTRA, i.e. filtered ventilation of the containments which had been found to be an important mitigative measure. The installation of the FILTRA at Barsebeck was completed by November 1985. For the other ten Swedish nuclear units plant specific severe accident studies, mainly using analytical tools derived from the IDCOR program, have been carried out. Based on the results obtained, requirements against overpressurization and for the mitigation of releases in case of a core melt accident have been given. The various mitigative measures are under review and verification. Results from the USNRC severe accident research program will be used in the verification. According to Governmental requirements the program should be completed before the end of the year 1988.

39814 (EUR—11019, pp 109-116) **Management of severe accidents.** Pelce, J.; Brignon, P. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. d'Analyse de Surete; Electricite de France, 75 - Paris). 1987. NTIS (US Sales Only), PC A13/MF A01. Order Number DE88780090/JAW. (CONF-8611215—).

From Seminar concerning safety studies on severe accident in light water reactors; Brussels, Belgium (10 Nov 1986).

In considering severe accidents in water power reactors, a major problem that arises is how to manage them in such a way that the situation can be controlled as well as possible, from the aspects both of preventing serious damage to the core of limiting the discharge of radioactivity. A number of countries have announced provisions in the field of accident management, some already set up, others planned, but these mainly apply to preventing damage to the core. Part of this report deals with this aspect, to show that there is a fairly wide consensus on how problems should be ap-

proached. Attitudes vary, on the other hand, in the approach to mitigate radioactive release. In fact, few countries have proposed concrete steps to manage severe accidents in the final stages when the core is seriously damaged. Since it is difficult to compare different approaches, only the French approach is described. This description is however very brief, because in the five or six years since it was defined, the approach has been presented many times. The stress is placed more on the comments which this type of approach suggests, to make the subsequent general discussion easier.

39815 (EUR—11019, pp 119-134) **Studies and proposed programme to meet new requirements regarding severe accidents in the Forsmark and Ringhals plants.** Espefaelt, R. (Swedish State Power Board, Waellingby). 1987. NTIS (US Sales Only), PC A13/MF A01. Order Number DE88780090/JAW. (CONF-8611215—).

From Seminar concerning safety studies on severe accident in light water reactors; Brussels, Belgium (10 Nov 1986).

In February 1986 licensing requirements regarding severe accidents in nuclear power plants were given by the Swedish Government. This regulation constitutes conditions for operation of the plants beyond 1988. The requirements are based on the conditions previously given for the Barsebaeck plant including construction of the filtered venting system FILTRA, which was completed at Barsebaeck in 1985. For the Forsmark and Ringhals plants a strategy has been adopted to meet the new requirements. A strong emphasis is put on both hardware and procedural measures to bring the reactor core back to stable cooling and maintain the containment integrity during an accident. The hardware modifications include measures to prevent temperature or pressure induced early containment spray and means for filtered venting of all plants to prevent late containment failure by overpressure. The ultimate aim is to minimize the radioactive release in a severe accident and meet a release limit set at 0.1% of the core fission product inventory excluding noble gases.

39816 (EUR—11019, pp 135-149) **How has severe accident analysis contributed to sizewell B and how can it continue to contribute in the future.** Harrison, J.R.; Western, D.J. (UKAEA Authority Health and Safety Secretariat, London). 1987. NTIS (US Sales Only), PC A13/MF A01. Order Number DE88780090/JAW. (CONF-8611215—).

From Seminar concerning safety studies on severe accident in light water reactors; Brussels, Belgium (10 Nov 1986).

Sizewell B is a proposed 1100 MWe PWR which is a UK development of the US SNUPPS design. The UK reference design document for the plant was first issued in 1981 and the Pre-Construction Safety Report (PCSR) was submitted to the Nuclear Installations Inspectorate (NII), the UK licensing authority, in 1982. A major public inquiry into the proposal took place between January 1983 and March 1985. This paper is concerned with the analysis of severe accidents. This means all the analysis that is concerned with those fault sequences that are outside the design basis of the plant and which may lead to severe consequences - either in terms of plant damage or release of radioactivity. This analysis comprises probabilistic assessments of the frequency of such sequences, transient analysis of the way such sequences develop and radiological release analysis. Part one of this paper examines how the severe accident analysis carried out for Sizewell B has contributed to the judgement that the design is sound and that the construction phase should proceed. The second part of the paper looks to the future and asks "Can severe accident analysis make any further contribution during the period from licensing up until operation commences.

39817 (EUR—11019, pp 151-154) **Severe accident considerations for modern KWU-PWR plants.** Eyink, J. (Kraftwerk Union A.G., Erlangen (DE)). 1987. NTIS (US Sales Only), PC A13/MF A01. Order Number DE88780090/JAW. (CONF-8611215—).

From Seminar concerning safety studies on severe accident in light water reactors; Brussels, Belgium (10 Nov 1986).

In assumption of severe accident on modern KWU-PWR plants the author discusses on the: selection of core meltdown sequences, course of the accident, containment behaviour and source terms for fission products release to the environment.

39818 (EUR—11019, pp 155-167) **Probabilistic assessment of the containment performance during severe accidents in PWRs.** Zaffiro, C. (Ente Nazionale per l'Energia Elettrica, Rome (IT)). 1987. NTIS (US Sales Only), PC A13/MF A01. Order Number DE88780090/JAW. (CONF-8611215—).

From Seminar concerning safety studies on severe accident in light water reactors; Brussels, Belgium (10 Nov 1986).

The aim of this paper is to discuss a way of assessing the external radioactive releases from the NPP Containment System during severe accidents, using information from the probabilistic assessment of core melt accidents (level 1 PSA). The discussion is mainly concerned with the definition of the Containment Accident Scenarios, which include consideration of both the degraded core physical status and the operating status of the Containment Safety Systems. For the discussion, reference is done to the available results of the PUN-PSA that is the level 1 PSA of the Italian PWR Standard Project. The Containment Reference Scenarios were considered as bases for developing the containment event trees, and determining the probabilistic distribution curves of the external radioactive releases. Calculations were made by the AGIP S.p.A. upon a contract with ENEA/DISP. Results of calculations were examined in view of defining probabilistic criteria for the containment performance, being the criteria aimed at minimizing the sanitary consequences and land contamination from external releases during severe accidents with the adoption of practical external protective actions. The paper concludes that satisfaction of the targets could require only minor design changes and consideration of a proper accident management by the operating crew through the use of in-plant emergency procedures.

39819 (EUR—11019, pp 169-182) **Overpressurization performance of containment structures.** Barr, P.; Bleackley, M.; Harrop, L.P.; Hargreaves, J.; Jowett, J.; Phillips, D.W. (UKAEA Safety and Reliability Directorate, Culcheth (GB)). 1987. NTIS (US Sales Only), PC A13/MF A01. Order Number DE88780090/JAW. (CONF-8611215—).

From Seminar concerning safety studies on severe accident in light water reactors; Brussels, Belgium (10 Nov 1986).

The containment building of a PWR is the outermost engineered barrier between the reactor and the environment. The most important element of such a containment system is the pressure boundary structure and its associated seals and penetrations. This containment structure is designed deterministically to withstand a number of loads and load combinations of which the dominant one is generally the internal pressure due to the double-ended guillotine break in one of the primary circuit loops. Typically, the design basis large LOCA produces a peak pressure increase in the region of 0.3 MPa in some 10 seconds and with a duration of up to a few tens of seconds. The assessment of overpressure performance of the containment structure is a key component of the PWR safety case, and is usually carried out by estimating a static factor of safety to some failure limit state. These estimates can be made using simple force-balance calculations or complicated finite element calculations, and both approaches have merit. In this paper we examine these approaches and discuss their value in estimating failure pressures and failure modes for a variety of internal pressurization transients. This discussion covers both general design and risk considerations and is illustrated by numerical examples taken from previous and on-going analysis.

39820 (EUR—11019, pp 183-189) **Depressurization-filtration system of the containment of French PWR's.** L'homme, A.; Schektman, N. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. d'Analyse de Surete; Electricite de France, 75 - Paris). 1987. NTIS (US Sales Only), PC A13/MF A01. Order Number DE88780090/JAW. (CONF-8611215—).

From Seminar concerning safety studies on severe accident in light water reactors; Brussels, Belgium (10 Nov 1986).

In the hypothetical event of a core meltdown occurring in a pressurized water reactor, and in order to preserve the integrity of the containment threatened by a build-up in pressure, EDF has developed, with the CEA, a decompression device which filters the containment internal atmosphere by using an unused containment penetration, and a sand-box, as filtering mechanism. This device

and its procedure for utilization, constitute the U5 procedure. Check-tests on a semi-industrial scale have been carried out at the Nuclear Research Centre at Cadarache, by using columns of sand 80 cm high, according to following varying criteria: the granulometry of the sand, that of the aerosols, the flow-through speed, and the percentage steam content of the fluid to be filtered. The filtering material chosen is sand of a median diameter of 0.6 mm. (log normal distribution). The purification factor is above 10. The device tested meets the chosen targets, and is applied today to French units on condition to simple modifications concerning specific aspects of different series. The first is expected to be put into service during 1987.

39821 (EUR—11019, pp 201-220) **Fission product source term in severe accident situations.** Friederichs, H.G. (Gesellschaft fuer Reaktorsicherheit (GRS), Koeln (DE)). 1987. (In German). NTIS (US Sales Only), PC A13/MF A01. Order Number DE88780090/JAW. (CONF-8611215—).

From Seminar concerning safety studies on severe accident in light water reactors; Brussels, Belgium (10 Nov 1986).

The present contribution describes results of calculations concerning the release of radioactive material. These calculations have been performed when preparing phase B of the German Risk Study and have been compared with corresponding results of phase A. In doing so, it has become evident that conservative assumptions could be reduced by a more detailed modelling in the calculations for phase B and that recent results are approximately one order of magnitude lower than those obtained for phase A. The second part of the report discusses how the release caused by the accident in the Chernobyl-reactor can be evaluated when taking into account the analysis performed hereto. A comparison between releases measured in Chernobyl and the calculated potential releases reveals fundamental differences in both the quantity and the nuclide specific composition of the released material.

39822 (EUR—11019, pp 221-226) **Fission product source term in severe accident situations.** Mostert, P.; Kema, N.V. 1987. NTIS (US Sales Only), PC A13/MF A01. Order Number DE88780090/JAW. (CONF-8611215—).

From Seminar concerning safety studies on severe accident in light water reactors; Brussels, Belgium (10 Nov 1986).

The utilities in Holland were asked to make a proposal for a new source term for the release of radioactivity to the environment. This source term, if accepted by the government, sould be used as an input for the site selection studies. As the source would also set an upper limit to the probability of a certain release of radioactivity it would also be a design objective for the new plants. The answer was found by a thorough analysis of existing PRA's.

39823 (EUR—11019, pp 227-240) **Severe accidents and source term research in Finland.** Kilpi, K. (Technical Research Centre of Finland, Helsinki). 1987. NTIS (US Sales Only), PC A13/MF A01. Order Number DE88780090/JAW. (CONF-8611215—).

From Seminar concerning safety studies on severe accident in light water reactors; Brussels, Belgium (10 Nov 1986).

Severe accident and source term research in Finland has gradually increased in significance in the aftermath of the TMI-2 and the Chernobyl accidents. Since 1983 a special research project, the Severe Accident Assessment project is being carried out in the Technical Research Centre of Finland (VTT). Typical annual research volume is 6..7 professional manyears. The project is funded by the Government, safety authority, VTT and power utilities. The objectives of the project are to acquire the understanding of the basic phenomena of severe accidents and establish tools for plant specific analysises and employ them for present and future nuclear plants in Finland. The project is divided into four different parts: 1) participation in international large scale experimental research projects and own experimental research, such as the Marviken and LACE projects and own small scale aerosol hygroscopicity tests. 2) Establishing tools for plant specific analysises, eg. through participation in the IDCOR program and through co-operation in code development and validation with various organizations, such as the EPRI and the KfK. 3) Plant specific analysises for present and future nuclear power plants in Finland by employing the severe accidents codes. 4) Follow-up and participation in other international research activities, such as the Nordic severe accident research program and the OECD/NEA working groups.

39824 (EUR—11019, pp 241) **Situation concerning severe accidents in Belgium.** Cavaco, P. 1987. NTIS (US Sales Only), PC A13/MF A01. Order Number DE88780090/JAW. (CONF-8611215—).

From Seminar concerning safety studies on severe accident in light water reactors; Brussels, Belgium (10 Nov 1986).

39825 (EUR—11019, pp 243-257) **Containing the "Incredible" (severe-accident and containment-design studies).** O'Farrelly, C. (Electricity Supply Board, Dublin (IE)). 1987. NTIS (US Sales Only), PC A13/MF A01. Order Number DE88780090/JAW. (CONF-8611215—).

From Seminar concerning safety studies on severe accident in light water reactors; Brussels, Belgium (10 Nov 1986).

This paper describes the analytical studies undertaken and the exceptionally tough safety criteria specified at the time the ESB was still considering a nuclear power station. Although the results of a 1970 ESB "upper-bound" study were over pessimistic, the study identified the seriousness of core-melt accidents, the wisdom of remote sitting, and the key importance of the containment as the last (and hopefully independent) barrier between the fission products and the environment. The emergency behaviour of Zr-canning caused much unease, which led to linear-power restrictions and additional ECCS requirements. These, together with tougher Containment and External Effects Criteria, were included in the ESB Reactor Specification which, in those days before TMI, was regarded by manufacturers as quite draconian. TMI stimulated a fundamental search for Reactor-Safety Design-Goals, and an ESB Feasibility Study suggested that the creation of a "forgiving" or inherently-safe reactor was achievable. The know-how exists and Chernobyl may provide the motivation to realize this worthwhile objective.

39826 (EUR—11019, pp 281-286) **Preliminary information on HDR-Test Results on the long-term behaviour of steam-partial pressure after LOCA experiments.** Karwat, H. (Technische Univ. Muenchen (DE)). 1987. NTIS (US Sales Only), PC A13/MF A01. Order Number DE88780090/JAW. (CONF-8611215—).

From Seminar concerning safety studies on severe accident in light water reactors; Brussels, Belgium (10 Nov 1986).

39827 (EUR—11019) **Studies of severe accidents in light-water reactors. Proceedings of the CEC seminar.** (Commission of the European Communities, Luxembourg). 1987. vp. (CONF-8611215—). NTIS (US Sales Only), PC A13/MF A01. Order Number DE88780090/JAW.

From Seminar concerning safety studies on severe accident in light water reactors; Brussels, Belgium (10 Nov 1986).

Seperate abstracts were prepared for the individual papers in this report. (JDB)

39828 (GRS-F—162) **List of reports in the field of reactor safety research sponsored by BMFT, CEA, EPRI, JSTA and USNRC. Reported period: July 1 - September 30, 1987.** (Gesellschaft fuer Reaktorsicherheit m.b.H. (GRS), Koeln (Germany, F.R.)). Nov 1987. 47p. (In German). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88753792/JAW.

The list reviews reports from the Federal Republic of Germany, from France, from Japan and from the United States of America concerning single problems in the field of reactor safety research. According to the cooperation of the Federal Minister for Research and Technology (BMFT) with the Commissariat a l'Energie Atomique (CEA), the Japan Science and Technology Agency (JSTA), the Electric Power Research Institute (EPRI) and the United States Nuclear Regulatory Commission, these reports are available in the Gesellschaft fuer Reaktorsicherheit (GRS). The list pursues the following order: Country of origin, problem area concerned, according to the Reactor Safety Research Programme of the BMFT, reporting organization. The list of reports appears quarterly. (orig.)

39829 **(INIS-BR—945) Risks of nuclear energy.** Menegassi, J. (Comissao Nacional de Energia Nuclear de Brasil, Rio de Janeiro). Jul 1986. 28p. (In Portuguese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88701600/JAW.

The risks for using nuclear energy to generate energy is discussed, and a comparisom between reactor accidents and other accidents is done. (E.G.).

39830 **(INIS-mf—11236) Principles of and comments on the application of protective measures to the public in case of nuclear accidents in nuclear facilities.** (Staatliches Amt fuer Atomsicherheit und Strahlenschutz, Berlin (German Democratic Republic)). 1987. 54p. (In German). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88703056/JAW.

The principles and explanations of the national regulatory body for the protection of the public in the event of a nuclear accident are published to assist local authorities in the emergency planning and preparedness. Main parts of the document are related to nuclear accident phases and accident consequences, evaluation of various protective measures, for example sheltering or evacuation, intervention levels and derived intervention levels. The appendix gives special information on administration of stable iodine, usage of radiation measuring instruments, and definitions of terms.

39831 **(INIS-mf—11639) Development of a two-phase pump model for PWR reactor coolant pumps. Final report.** Seeberger, G.J.; Schneider, K. (Kraftwerk Union A.G., Erlangen (Germany, F.R.); Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.)). 1986. 204p. (In German). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88752653/JAW.

The mortel explains the changes in delivery performance due to phase slippage and phase separation in the impeller and due to the compressibility of the pumped medium. After significant coefficients have been determined, dimensional analysis is used to derive correlations which describe the degradation of pump head and of the hydraulic torque. Unknowns in these correlations are determined by empirical means. It is demonstrated that geometric scaling is possible; finally, the model is evaluated. With 26 refs., 87 figs..

39832 **(INIS-mf—11641) Application of leak before break concepts piping of KWU-plants.** Bartholome, G.; Bieselt, R.W. (Kraftwerk Union A.G., Muelheim an der Ruhr (Germany, F.R.)). 1985. 32p. (CONF-8511248—). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88752655/JAW.

From Meeting on recent trends in the development of primary circuit technology; Madrid, Spain (25 Nov 1985).

The fracture of pipes with longitudinal and circumferential cracks was investigated by experiments and theoretical approaches (flow stress criteria and limit load analyses). The experiments show that the critical crack dimensions can conservatively be determined by fracture mechanics. The tests and calculations are applied to KWU primary coolant piping with hypothetical longitudinal and circumferential defects. Reactor systems, design, fabrication, stress analysis, material, non-destructive testing, quality control and in-service inspection are considered referring to the leak-before-break behaviour. On the basis of the extreme toughness of the materials, the known loads, the high level of non-destructive examinations, the leakage monitoring system and the high quality of manufacture and processing it is shown that a spontaneous failure need not be postulated.

39833 **(INIS-mf—11662) Documentation presented by the Land government of Baden-Wuerttemberg, on the impacts of the Chernobyl reactor accident and the measures taken. Vol. 1-3. Vol. 1: Impacts and measures taken. Data as of March 1987. Vol. 2: Data measured in Baden-Wuerttemberg. Data as of 28 August 1986. Vol. 3: Data measured in Baden-Wuerttemberg. Data as of 15 March 1987.** (Ministerium fuer Ernaehrung, Landwirtschaft, Umwelt und Forsten Baden-Wuerttemberg, Stuttgart (Germany, F.R.)). 1987. 2439p. (In German). NTIS (US Sales Only), PC A99/MF A01. Order Number DE88752664/JAW.

The first volume of the documentation starts with basic facts and data of environmental radioactivity and radiation exposure in general and then proceeds to discussions of the specific problems resulting from the reactor accident. The reactor accident scenario is described, and the impacts are explained, as well as measures taken by the EC, the German Federal Government, and the Land government of Baden-Wuerttemberg. The concept and strategies set up by the Land government for improving precautionary and emergency measures within the framework of disaster control are explained. The second and third volumes present measured data taken from April to August 28, 1986 (2nd volume) and from August 29, 1986 to end of February, 1987. The data measured in the various regions of the Land are arranged by government districts, administrative county, and date.

39834 **(INIS-mf—11741) Safety aspects of nuclear power plants nearby urban areas. A balance taking into account modern probabilistic schemes and a tentative safety concept.** Kroeger, W. (Wuppertal Univ. (Gesamthochschule) (Germany, F.R.). Fachbereich 14 - Sicherheitstechnik). 27 Feb 1986. 185p. (In German). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88754017/JAW.

According to the Environmental Experts Council smaller reactors would correspond best to the heat demand of the Federal Republic of Germany. The study discusses and investigates into the present safety concepts and site selection criteria, trends towards power plant sites nearby urban areas, site-dependent parameters and their influence on the extent of damage, protective aims, compatibility of the protective aims proposed, and the protective measures required.

39835 **(JAERI-M—88-019) Dose estimates in Japan following the Chernobyl reactor accident.** Togawa, Orihiko; Homma, Toshimitsu; Iijima, Toshinori; Midorikawa, Yuji. (Japan Atomic Energy Research Inst., Tokyo). Feb 1988. 52p. (In Japanese). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88753632/JAW.

Estimates have been made of the maximum individual doses and the collective doses in Japan following the Chernobyl reactor accident. Based on the measured data of ground deposition and radionuclide concentrations in air, raw milk, milk on sale and leafy vegetables, the doses from some significant radionuclides were calculated for 5 typical exposure pathways; cloudshine, groundshine, inhalation, ingestion of milk and leafy vegetables. The maximum effective dose equivalents for hypothetical individuals were calculated to be 1.8 mrem for adults, 3.7 mrem for children and 6.0 mrem for infants. The collective effective dose equivalent in Japan was estimated to be 5.8 x 10/sup 4/ man center dot rem; 0.50 mrem of the average dose per capita.

39836 **(JAERI-M—88-020) TRANCS, a computer code for calculating fission product release from high temperature gas-cooled reactor fuel, (2). Radial transport in fuel rod.** Hayashi, Kimio; Fukuda, Kousaku. (Japan Atomic Energy Research Inst., Tokyo). Feb 1988. 58p. (In Japanese). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88754107/JAW.

This report describes the calculation procedure of the TRANCS code, which deals with fission product transport in fuel rod of high temperature gas-cooled reactor (HTGR). The fundamental equation modeled in the code is a cylindrical one-dimensional diffusion equation with generation and decay terms, and the non-stationary solution of the equation is obtained numerically by a finite difference method. The generation terms consist of the diffu-

sional release from coated fuel particles, recoil release from outermost coating layer of the fuel particle and generation due to contaminating uranium in the graphite matrix of the fuel compact. The decay term deals with neutron capture as well as beta decay. Factors affecting the computation error has been examined, and further extention of the code has been discussed in the fields of radial transport of fission products from graphite sleeve into coolant helium gas and axial transport in the fuel rod.

39837 **(JAERI-M—88-039) Estimation of leak rates through a through-wall cracked pipes using Moody's critical flow model.** Tyujyo, Noriyuki; Shibata, Katsuyuki; Isozaki, Toshikuni; Onizawa, Kunio. (Japan Atomic Energy Research Inst., Tokyo). Mar 1988. 46p. (In Japanese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88754120/JAW.

To introduce Leak-Before-Break (LBB) concept into the piping design standard of the LWR pressure boundary piping, LBB research and verification test programs are actively conducted in many nuclear electricity generating countries. It is an important subject to evaluate the leak rate through a through-wall cracked pipes for the verification of LBB. At JAERI, a leak test program has started in 1987 in order to measure leak rates of coolant through cracks in 4- and 6-inch diameter pipes and through slit specimens. Using the Moody's critical flow model, a computer program to evaluate a leak rate through a through-wall cracked pipes has been developed in order to determine the crack angle of test pipes in the leak test. This report describes the Moody's critical flow model, the outline of the computer program and the results of preliminary calculations.

39838 **(JAERI-M—88-048) Evaluation of the trial design studies for an advanced marine reactor, (1). Reactors.** (Japan Atomic Energy Research Inst., Tokyo). Mar 1988. 128p. (In Japanese). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88754125/JAW.

The trial design of three type reactors, semi-integrated, integrated and integrated (self-pressurized) type, was carried out in order to clarify the reactor type for the advanced marine reactor that would be developed for its realization in future and in order to extract its research and development theme. The trial design was carried and finished as for the three type reactors in same specifications in order to improve the following characteristics, small in size, light in weight, high in safety and reliability, and economic. In this report, a comparison and review of the following items are described as for the above three type reactors, (1) specifications, (2) shielding, (3) refueling, (4) in-service inspection, (5) analysis of the transients and accidents, (6) piping systems, (7) control systems, (8) dynamic analysis, (9) overall comparison, (10) research and development theme and theme for study in future.

39839 **(JAERI-M—88-049) Evaluation of the trial design studies for an advanced marine reactor, (2). Fuel specific characteristics, (1): cylindrical fuel rod.** Ambo, Noriaki; Nakajima, Tetsuo; Yokomura, Takeyoshi. (Japan Atomic Energy Research Inst., Tokyo). Mar 1988. 61p. (In Japanese). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88753634/JAW.

We researched and studied the fuel specific characteristics of a cylindrical fuel rod to evaluate the trial design fuels of three type reactors (four cores) of the Advanced Marine Reactor, and executed PCI (Pellt-Clad Interaction) analysis and evaluation of its analysis outputs to evaluate the behavior of three cylindrical trial design fuel rods in the rapid load change that was a requirement of a marine reactor fuel.

39840 **(JAERI-M—88-050) Evaluation of the trial design studies for an advanced marine reactor, (2). Fuel specific characteristics, (2): CARAMEL (plate-type) fuel.** Ambo, Noriaki; Yokomura, Takeyoshi. (Japan Atomic Energy Research Inst., Tokyo). Mar 1988. 39p. (In Japanese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88753635/JAW.

As for the CARAMEL fuel (plate-type fuel) that was the fuel of the integrated-type reactor which was one of the trial design studies for an Advanced Marine Reactor, its structure and its fuel specific characteristics were studied and compared with a fuel rod (cylindrical fuel), and the total characteristics of the caramel fuel was reviewed and evaluated.

39841 **(JAERI-M—88-051) Evaluation of the trial design studies for an advanced marine reactor, (3). Core specific characteristics.** Ambo, Noriaki; Yokomura, Takeyoshi. (Japan Atomic Energy Research Inst., Tokyo). Mar 1988. 68p. (In Japanese). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88753636/JAW.

JAERI have carried out four core designs for three different type reactors (Semi-Integrated, Integrated and Integrated (self-pressured) type reactors), as the trial designs of an Advanced Marine Reactor for three years (1983 ~ 1985). This report describes the result of comparison and studies of the core specific characteristics of these four cores, which include core concept, specifications, core life, specific power density, burn-up, reactivity control and etc. In conclusion, it was found that the Integrated type reactor core and the Semi-Integrated type reactor core designs satisfy the conditions of long core life (four years), high specific power density (50 ~ 61 kw/l) and high burn-up (30,000 ~ 32,000 MWD/t), so these two cores will be optimum designs based on the present technologies.

39842 **(JAERI-M—88-053) Evaluation of the trial design studies for an advanced marine reactor, (5). Containment.** Imamura, Yoshiaki; Yokomura, Takeyoshi. (Japan Atomic Energy Research Inst., Tokyo). Mar 1988. 29p. (In Japanese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88753637/JAW.

The trial design of three type reactors, semi-integrated, integrated and integrated (self-pressurized) type, was carried out in order to clarify the reactor type for the advanced marine reactor that would be developed for its realization in future and in order to extract its research and development theme. In this report, a comparison and evaluation of the containment vessel types for the above trial design are described. Two containment vessel types, pressure suppression type integrated with the hull and dry type, are compared and evaluated from the following points of view, light in weight, small in size, high in safety and reliability, and economic. As the results, it becomes clear that the pressure suppression type containment vessel integrated with the hull is feasible.

39843 **(JAERI-M—88-055) Evaluation of trial design studies for an advanced marine reactor, (7). Shielding, (1): evaluation of shielding design.** Ise, Takeharu; Narita, Hideo; Itoh, Yasuyoshi. (Japan Atomic Energy Research Inst., Tokyo). Mar 1988. 52p. (In Japanese). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88753639/JAW.

We have performed the numerical evaluation of shielding design for three advanced marine reactors (semi-integral PWR, integral PWR and self-pressurized PWR) under operational condition and hypothetical accident. Common calculational procedure and shielding material ingredient over the three reactors have been adopted for fair evaluation.

39844 **(JAERI-M—88-056) Assessment of preliminary design of advanced marine reactor, (7). Shielding, (2): a study on the optimum shielding design.** Takeuchi, Kiyoshi; Tanaka, Shunichi; Itoh, Yasuyoshi; Yokomura, Takeyoshi. (Japan Atomic Energy Research Inst., Tokyo). Mar 1988. 38p. (In Japanese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88753640/JAW.

It is essential to define what should be optimized for the purpose of shielding optimization of a reactor. In general, a marine reactor should demand the limitation of its weight and space as well as setting up adjacent room for crews to itself. As a result, it is indispensable for the design of the marine reactor optimize its shield so as to reduce its shield weight and also the radiation dose to crews. The preset study aims at evaluation on the reduction of both the shield weight and the radiation dose to crews in each shielding design for each marine reactor three proposed reactors. A further study is made to fined a means to reduction of the weight of a secondary shield occupying large percent of the total weight of the marine reactor. In particular, the discussion is focused on the possi-

bility of new design of so effective secondary shielding as to protect radiations in case of a reactor accident.

39845 **(JAERI-M—88-058) Localized deformation of zirconium-liner tube.** Nagase, Fumihisa; Uchida, Masaaki. (Japan Atomic Energy Research Inst., Tokyo). Mar 1988. 29p. (In Japanese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88753641/JAW.

Zirconium-liner tube has come to be used in BWR. Zirconium liner mitigates the localized stress produced by the pellet-cladding interaction (PCI). In this study, simulating the ridging, stresses were applied to the inner surfaces of zirconium-liner tubes and Zircaloy-2 tubes, and, to investigate the mechanism and the extent of the effect, the behavior of zirconium liner was examined. As the result of examination, stress was concentrated especially at the edge of the deformed region, where zirconium liner was highly deformed. Even after high stress was applied, the deformation of Zircaloy part was small, since almost the concentrated stress was mitigated by the deformation of zirconium liner. In addition, stress and strain distributions in the cross section of specimen were calculated with a computer code FEMAXI-III. The results also showed that zirconium liner mitigated the localized stress in Zircaloy, although the affected zone was restricted to the region near the boundary between zirconium liner and Zircaloy.

39846 **(JAERI-M—88-060) Evaluation report on SCTF Core-III tests S3-14, S3-15 and S3-16. Effect of radial power profile shape on two-dimensional thermal-hydraulic behavior in core.** Iwamura, Takamichi; Iguchi, Tadashi; Akimoto, Hajime; Okubo, Tsutomu; Ohnuki, Akira; Sakaki, Isao; Adachi, Hiromichi; Murao, Yoshio. (Japan Atomic Energy Research Inst., Tokyo). Mar 1988. 158p. NTIS (US Sales Only), PC A08/MF A01. Order Number DE88753642/JAW.

It was revealed from previous reflood tests using Slab Core Test Facility (SCTF) that the heat transfer was enhanced in high power bundles and degraded in low power bundles due to the radial power distribution. In the present study, the effects of local power ratio itself and the shape of radial power distribution were separately investigated by comparing three tests: S3-14 (flat power distribution), S3-15 (inclined power distribution) and S3-16 (steep power distribution). Those three tests were performed under the same boundary conditions, total power and initial stored energy. The emergency core cooling (ECC) water was injected into the lower plenum. The test results indicated that the heat transfer enhancement and degradation was governed mainly by the bundlewise radial power ratio and less dependent on the shape of radial power distribution when the difference in power ratios between adjacent bundles is less than 0.44. The degree of heat transfer enhancement at high power bundles was increased with the radial peak power ratio. Even at an average power bundle, the heat transfer was enhanced in the non-uniform radial power distribution tests.

39847 **(JAERI-M—88-075) Experimental study of mixed convective heat transfer in narrow vertical rectangular channel, (2). With water gap of 2.5 mm.** Usui, Tohru; Kaminaga, Masanori; Sudo, Yukio. (Japan Atomic Energy Research Inst., Tokyo). Mar 1988. 45p. (In Japanese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88753645/JAW.

During some anticipated operational occurrences and accident conditions, which were posturated in the JRR-3 safety assessment, there is a case that core flow decreases from steady-state downward forced convective flow to zero flow and at last becomes upward flow due to the natural circulation induced between the core and the reactor pool, that is, core flow reversal occurs. During the core flow reversal, the mixed convective heat transfer becomes significant. In this case it is important to understand the heat transfer characteristics of the mixed convection to evaluate the heat transfer of the fuel plates. To investigate the heat transfer characteristics of the mixed convection, heat transfer experiments were carried out using a vertical rectangular channel with water gap of 2.5 mm, which was nearly equal to that of the subchannels of the standard fuel elements of the upgraded JRR-3. In conclusion the heat transfer correlations which can be applied for a narrow vertical channel in free, mixed and forced convections were obtained. The range of the mixed convection region was identified by the non dimensional parameter Gr/sub x//Re/sub x//sup 2l///sup 8/Pr/sup 1/2/. It was confirmed that in the mixed convection in a narrow channel, the influence of the acceleration of the main flow owing to the development of the boundary layer played a important part in the promotion of the heat transfer, compared with the case along a flat plate or in a wide channel.

39848 **(KFK—4100) Nuclear Safety Project. Annual report 1986.** (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Projekt Nukleare Sicherheit). Sep 1987. 358p. (In German). NTIS (US Sales Only), PC A16/MF A01. Order Number DE88754024/JAW.

The annual report 1986 is a detailed description of work within the Nuclear Safety Project performed in 1986 in the nuclear safety field by KfK institutes and departments and by external institutes on behalf of KfK. It includes individual research activities on dynamic loads and strains of reactor components under accident conditions, fuel behaviour under accident conditions, investigation and control of LWR core-meltdown accidents, improvement of fission product retention and reduction of radiation exposure, and on behaviour, impact and removal of released pollutants.

39849 (KFK—4100, pp 4100/1-4100/17) **Failure pressure and failure mode of the bolted connection for the large component port in German PWR containments.** Goeller, B.; Krieg, R.; Messemer, G.; Wolf, E. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Reaktorentwicklung). Sep 1987. NTIS (US Sales Only), PC A16/MF A01. Order Number DE88754024/JAW.

In Nuclear Safety Project. Annual report 1986.

For the recent German PWR, containment failure due to overpressurization is controlled by the mechanical behavior of the bolted connection between the containment shell and the large component part. Of essential influence is also the sealing box which covers the bolted connection. Both parts have been investigated. For Philippsburg-2 containment overpressurization leads to a local failure between 12.9 and 13.7 bar. For the Konvoi-type of reactor, the critical pressure may reach values up to 143 bar. In this case, however, global failure with severe mechanical damage cannot be ruled out.

39850 (KFK—4100, pp 4100/37-4100/49) **Application of the flooding option of the RELAPS/MOD2 LWR thermohydraulic code to a SEFLEX experiment.** Jacobs, G.; Galvan, A. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Neutronenphysik und Reaktortechnik; Institut Nacional de Investigaciones Nucleares, Mexico City). Sep 1987. (In German). NTIS (US Sales Only), PC A16/MF A01. Order Number DE88754024/JAW.

In Nuclear Safety Project. Annual report 1986.

Using the code RELAP5/2/36.04, which has been installed on a CRAY X-MP at KFA Juelich via network tele-communication, post-test analyses of forced reflood tests of the SEFLEX- and FLORESTAN experimental programmes have been performed. A consolidated KfK-version of COMMIX-2 has been transmitted to ANL. It contains most options of COMMIX-1B (excluding the skew-upwind technique) as well as new routines for the linewise, planewise, or regionwise integration of the Poisson-type pressure and enthalpy equations. Main progress in the vectorization of COMMIX-2 was the implementation of red/black-SOR-algorithms for the solution of the Poisson-type equations.

39851 (KFK—4100, pp 4100/54-4100/67) **COMMIX model investigations for the HDR main test T32.11 and T32.36.** Baumann, W.; Schygulla, U. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Neutronenphysik und Reaktortechnik; Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Projektbereich Heissdampfreaktor - Sicherheitsprogramm/Handhabungstechnik). Sep 1987. (In German). NTIS (US Sales Only), PC A16/MF A01. Order Number DE88754024/JAW.

In Nuclear Safety Project. Annual report 1986.

In order to investigate the effect of the k-turbulence model of COMMIX-1B, the HDR main tests T32.11 and T32.36 were re-

calculated for laminar and turbulent flow conditions. Part of the turbulent flow calculations were duplicated using the KfK-reference version of COMMIX-2. In an additional effort, a benchmark calculation for thermal buoyancy phenomena at a pipe/plenum interface proposed by ANL experimenters and organized by IAHR was conducted up to 2000 s transient time.

39852 (KFK—4100, pp 4100/68-4100/78) **Calculation of the first APWR-experiment with the FLUT code.** Cigarini, M. Sep 1987. (In German). NTIS (US Sales Only), PC A16/MF A01. Order Number DE88754024/JAW.

In Nuclear Safety Project. Annual report 1986.

For the analysis of the refill and reflood phases of the LOCA the FLUT code was modified: new correlations to evaluate the friction losses in an APWR geometry (as in the modified RELAP5) and a new model for the droplet diameter in the region just above the quench front were introduced. The KfK-version of the program was tested by means of the post-test analysis of reflood experiments in both PWR (FLECHT and SEFLEX facilities) and APWR (FLORESTAN facility) bundles.

39853 (KFK—4100, pp 4200/9-4200/27) **Mechanical and chemical behaviour of Zircaloy-4 cladding and UO/sub 2/ fuel during severe core damage transients.** Hofmann, P.; Adelhelm, C.; Garcia, E.; Markiewicz, M.; Burbach, J.; Gausmann, G.; Kurz, K.; Metzger, H. Sep 1987. (In German). NTIS (US Sales Only), PC A16/MF A01. Order Number DE88754024/JAW.

In Nuclear Safety Project. Annual report 1986.

The verification has been completed of the PECLOX model used for the theoretical description of cladding tube oxidation by the UO/sub 2/ fuel and steam. A better agreement between the experimental results and the calculations has been achieved among others by new material properties data. For instance, an oxygen diffusion coefficient in the ZrO/sub 2/ layer was assumed for the temperature transient experiments which is not only dependent on the temperature but also on the heating rate.

39854 (KFK—4100, pp 4200/53-4200/55) **Examinations of the fuel rod behaviour of advanced pressure water reactors during accident conditions.** Hofmann, P.; Liesenfeld, U.; Markiewicz, M.; Burbach, J.; Metzger, H. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Material- und Festkoerperforschung 1 - Teilinstitut Kernbrennstoffe). Sep 1987. (In German). NTIS (US Sales Only), PC A16/MF A01. Order Number DE88754024/JAW.

In Nuclear Safety Project. Annual report 1986.

The mechanical properties of one ferritic-martensitic steel (1.4914) and two austenitic Cr-Ni steels (RGTX1, RGTX2, with about 25 wt.% Ni and 10% Cr) are examined in the presence of simulated fission products (Cs/sub 2/Te) and compared with the results of the reference austenitic stainless steel 1.4970 (15 wt.% Cr, 15% Ni).

39855 (KFK—4100, pp 4300/1-4300/13) **Reaction behaviour, activity release and transport of fission products during core meltdown.** Bunz, H.; Koyro, M.; Schoeck, W. Sep 1987. (In German). NTIS (US Sales Only), PC A16/MF A01. Order Number DE88754024/JAW.

In Nuclear Safety Project. Annual report 1986.

The work on the NAUA code consisted of the implementation of additional modules which enable calculations of aerosol behaviour in boiling water reactors. Most of these calculations are performed by KWU in the frame of a BWR risk analysis. In DEMONA the two last tests of the test matrix have been carried out, the mixed aerosol test AB and the multicompartment test A9. In the mixed aerosol test a mixture of iron oxide and tin oxide aerosols was used which was produced in separate generators and at different times. The overall removal was identical to the pure tin oxide tests B3 and B4. The composition of the aerosol particles was analysed, the expected rapid homogenizing due to coagulation was confirmed, also no composition differences were found as a function of particle size.

39856 (KFK—4100, pp 4300/14-4300/32) **Development of models for the analytical determination of core meltdown accidents.** Alsmeyer, H.; Dres, K.; Reimann, M.; Stiefel, S.; Benz, H.; Oehmann, M.; Schoenthal, E.; Ziegler, H. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Reaktorbauelemente; Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Hauptabteilung Kerntechnische Betriebe). Sep 1987. (In German). NTIS (US Sales Only), PC A16/MF A01. Order Number DE88754024/JAW.

In Nuclear Safety Project. Annual report 1986.

The final BETA experiment conducted with siliceous concrete and addition of metallic zirconium to the melt, showed no unexpected effects including gas chemistry. The very fast and highly exothermal Zr-oxidation contributes considerably the energy release in the melt, as is modelled in the computer codes. The series of 19 BETA tests is considered a sufficient experimental data base to calculate melt concrete interaction in a typical PWR plant for silicate concrete and late containment failure, and to assist in the assessment of possible measures to reduce the consequences. The BETA working group concluded that understanding and modelling of MCCI (WECHSL code) is sufficient for the application to the German PWR with respect to gas release, temperature history of the melt, and concrete erosion.

39857 (KFK—4100, pp 4400/35-4400/44) **Investigations on the retention of iodine by sorbents in the case of fire.** Deuber, H.; Giraud, V. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Lab. fuer Aerosolphysik und Filtertechnik 2). Sep 1987. (In German). NTIS (US Sales Only), PC A16/MF A01. Order Number DE88754024/JAW.

In Nuclear Safety Project. Annual report 1986.

Investigations were performed on the influence of gaseous combustion products from four relevant materials used in NPPs on the retention of methyl iodide (CH/sub 3/I--131) by four commercial impregnated activated carbons. The materials used to produce the combustion products were a PVC cable, a FRNC cable, a mineral oil and a paint. The carbons differed in base material (coal or coconut shell) and/or impregnant (KI or TEDA). The results show that with iodine filters of large bed depths and residence times (e.g. 25 cm and 0,5 s, respectively), when containing a usually employed impregnated activated carbon, a sufficiently high retention of iodine can be achieved even with a high challenge of gaseous combustion products from relevant materials used in NPPs.

39858 (KFK—4100, pp 4200/28-4200/52) **Out-of-pile bundle experiments for severe fuel damage investigations (CORA): Experiment B with Al/sub 2/O/sub 3/ pellets.** Hagen, S.; Hain, K.; Butzer, W.; Gruenhagen, A.; Hanauer, J.; Harbauer, G.; Hering, W.; Lange, W.; Leiling, W.; Malauschek, H. Sep 1987. (In German). NTIS (US Sales Only), PC A16/MF A01. Order Number DE88754024/JAW.

In Nuclear Safety Project. Annual report 1986.

The power input was increased in a way to reach a temperature rise of 0.5/sup 0/C in the hottest parts of the bundle. The maximum power was 80 kW. With this power input a temperature of 2000/sup 0/C was reached. This heatup resulted in a nearly complete melting of the middle bundle region. The molten material refroze in the lower end of the bundle. Similar as for the UO/sub 2//Zry system we got the dissolution of the ceramic component in contact with the Zry far below the melting temperature of Al/sub 2/O/sub 3/. Zry takes oxygen from Al/sub 2/O/sub 3/ resulting in metallic aluminium. The melt formation in this system is much more pronounced than for UO/sub 2//Zry. Thus our first preliminary results are in good agreement with the experience in the TMI 2 core. Also there in the surrounding of the burnable poison rods a pronounced damage was found.

39859 (KFK—4100, pp 4800/1-4800/26) **Investigations of radiological impact of accidents under probabilistic aspects.** Al-Omari, I.; Bayer, A.; Braun, J.; Burkart, K.; Ehrhardt, J.; Fischer, F.; Hasemann, I.; Paesler-Sauer, J.; Panitz, H.J.; Steinhauer, C. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Neutronenphysik und Reaktortechnik). Sep 1987. (In German). NTIS (US Sales Only), PC A16/MF A01. Order Number DE88754024/JAW.

In Nuclear Safety Project. Annual report 1986.

A new concept of atmospheric dispersion modelling of UFOMOD has been developed. The new code consists of two parts: the near range model using MUSEMET or RIMPUFF to calculate emergency actions and early fatalities and the far range model using MESOS (ICST, UK) to assess late health effects and long term countermeasures. An important part of work has been focussed on updating the computer code UFOMOD with respect to the dose calculations for external exposure and for internal exposure from ingestion. To assess the stochastic somatic health effects, new age- and sex-dependent dose-risk conversion factors are now being implemented in UFOMOD. The data were provided by the GSF and are based on either a relative or an absolute risk model, dependent on the type of the effect. Linear and linear-quadratic dose-risk dependencies will be applied for leukemia and cancers of the bone surface, thyroid, lung, GI-tract and other organs. The revision of the foodchain part of UFOMOD has been almost completed in the reporting period.

39860 **(KTA-GS—52) KTA status report I/1987.** (Kerntechnischer Ausschuss (KTA), Koeln (Germany, F.R.)). Jul 1987. 55p. (In German). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88752677/JAW.

The status report I/1987 gives an account of the KTA activities and achievements in the regulatory sector in the period between November 26, 1986 to May 31, 1987. The survey of rules and codes approved of has been elaborated in cooperation with the chairmen of the working groups and sub-committees. The report is intended to provide quick information on developments in the nuclear regulatory system. Information on regulatory work in progress is given in the KTA manual, indicating changes, e.g. in subject fields, technical details, time-schedules, or members of working groups.

39861 **(NEI-DK—85) Stress analysis of R2 pressure vessel. Structural reliability benchmark exercise.** Vestergaard, N. (Risoe National Lab., Roskilde (Denmark)). May 1987. 65p. NTIS (US Sales Only), PC A04/MF A01. Order Number DE88754089/JAW.

The Structural Reliability Benchmark Exercise (SRBE) is sponsored by the EEC as part of the Reactor Safety Programme. The objectives of the SRBE are to evaluate and improve 1) inspection procedures, which use non-destructive methods to locate defects in pressure (reactor) vessels, as well as 2) analytical damage accumulation models, which predict the time to failure of vessels containing defects. In order to focus attention, an experimental pressure vessel has been inspected, subjected fatigue loadings and subsequently analysed by several teams using methods of their choice. The present report contains the first part of the analytical damage accumulation analysis. The stress distributions in the welds of the experimental pressure vessel were determined. These stress distributions will be used to determine the driving forces of the damage accumulation models, which will be addressed in a future report.

39862 **(NUREG—0781-Suppl.5) Safety Evaluation Report related to the operation of South Texas Project, Units 1 and 2 (Docket Nos. 50-498 and 50-499).** (Nuclear Regulatory Commission, Washington, DC (USA). Div. of Reactor Projects, III, IV, V). Mar 1988. 91p. NTIS, PC A05/MF A01. Order Number TI88900625/JAW.

In April 1986 the staff of the US Nuclear Regulartory Commission issued its Safety Evaluation Report (NURED-0781) regarding the application of Houston Lighting and Power Compananny (applicant and agent for the owners) for a license to operate South Texas Project, Units 1 and 2 (Docket Nos. 50-498 and 50-499). The facililty is located in Matagorda County, Texas, west of the Colorado River, 8 miles north-northwest of the town of Matagorda and about 89 miles southwest of Houston. The first supplement to NUREG-0781 was issued in September 1986, the second supplement in January 1987, the third supplement in May 1987, and the fourth supplement in July 1987. This fifth supplement provides updated information on the issues that had been considered previously as well as the evaluation of issues that have arisen since the fourth supplement was issued. The evaluation resolves all the issues necessary to support the issuance of a full-power license for Unit 1.

39863 **(NUREG—1002-Suppl.6) Safety Evaluation Report related to the operation of Braidwood Station, Units 1 and 2 (Docket Nos. STN 50-456 and STN 50-457).** (Nuclear Regulatory Commission, Washington, DC (USA). Div. of Reactor Projects III, IV, V and Special Projects). Jun 1988. 28p. NTIS, PC A03/MF A01 - GPO;1. Order Number TI88012255/JAW.

In November 1983, the staff of the Nuclear Regulatory Commission issued its Safety Evaluation Report (NUREG-1002) regarding the application filed by the Commonwealth Edison Company, as applicant and owner, for a license to operate Braidwood Station, Units 1 and 2 (Docket Nos. 50-456 and 50-457). The first supplement to NUREG-1002 was issued in September 1986; the second supplement was issued in October 1986; the third supplement was issued in May 1987; the fourth supplement was issued in July 1987 in support of the full power license for Unit 1; the fifth supplement was issued in December 1987 in support of the low power license for Unit 2. This sixth supplement to NUREG-1002 is in support of the full-power license for Unit 2 and provides the status of items that remained unresolved at the time Supplement 5 was published. The facility is located in Reed Township, Will County, Illinois.

39864 **(NUREG—1286-Suppl.1) Safety evaluation report related to the restart of Rancho Seco Nuclear Generating Station, Unit 1, following the event of December 26, 1985 (Docket No. 50-312).** (Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Reactor Regulation). Mar 1988. 230p. NTIS, PC A11/MF A01 - GPO;1. Order Number TI88900627/JAW.

On December 26, 1985 the Rancho Seco Nuclear Generation Station experienced a reactor trip from 76% power, followed by a rapid overcooling transient and automatic initiation of the safety features actuation system. The unit has remained shut down since that time. In response to confirmatory letters from the NRC Region V Administrator, the licensee, Sacramento Municipal Utility District (SMUD), submitted the "Rancho Seco Action Plan for Performance Improvement" in July 1986. Since then, the licensee has submitted revisions to that action plan and numerous other documents and information to support a return of Rancho Seco to power operation. The NRC staff reviewed the licensee's submittals and other information made available to the staff in support of a restart of Rancho Seco. In October 1987, the NRC staff issued a Safety Evaluation Report (NUREG-1286) relating to the restart of Rancho Seco. Since then, the staff has completed its review of all other issues relating to the restart effort. The results of this more recently completed review work are contained in this Supplement No. 1 to NUREG-1286 (SSER 1).

39865 **(NUREG—1305) Technical Specifications, South Texas Project, Unit No. 1 (Docket No. 50-498): Appendix "A" to License No. NPF-76.** (Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Reactor Regulation). Mar 1988. 444p. NTIS, PC A19/MF A01 - GPO;1. Order Number TI88900626/JAW.

The South Texas Project, Unit No. 1, Technical Specifications were prepared by the US Nuclear Regulatory Commission to set forth the limits, operating conditions, and other requirements applicable to a nuclear reactor facility as set forth in Section 50.36 of 10 CFR 50 for the protection of the health and safety of the public. This report is Appendix A to License No. NPF-76.

39866 **(NUREG—1311) Funding the NRC training program for states.** Lubenau, J.O.; Corley, J.H.; Kammerer, C. (Nuclear Regulatory Commission, Washington, DC (USA). Office of Governmental and Public Affairs). Jun 1988. 66p. NTIS, PC A04/MF A01 - GPO. Order Number TI88012640/JAW.

On February 3, 1988, the Commission received a briefing on the State, Local and Indian Tribes Programs of the NRC Office of Governmental and Public Affairs. The briefing included discussion of the Agreement State program and, more particularly, the training provided to State personnel to help them maintain programs which are adequate to protect public health and safety and compatible with the Commission's program. The Commission endorsed the NRC State training program but questioned the long-standing practice of paying the travel and per diem of State personnel approved to attend the NRC sponsored training. The staff was requested by the Commission to provide a report on this aspect. The report is the staff's response. It includes an evaluation of the practice of funding State travel and per diem costs for personnel attending NRC courses and other options to make this program more cost effective including utilizing whenever possible minimal cost Federal and commercial training facilities.

39867 (NUREG—1325) **Disposition of recommendations of the National Research Council in the report "Revitalizing Nuclear Safety Research".** (Nuclear Regulatory Commission, Washington, DC (USA)). Jun 1988. 36p. NTIS, PC A03/MF A01 - GPO;1. Order Number TI88012340/JAW.

On December 8, 1986, the Committee on Nuclear Safety Research of the National Research Council submitted its report, "Revitalizing Nuclear Safety Research," to the US Nuclear Regulatory Commission (NRC). The Commission and its staff have carefully reviewed the Committee's report and have extensively examined the planning, implementation, and management of NRC research programs in order to respond most effectively to the Committee's recommendations. This report presents the Commission's view of the Committee's report and describes the actions that are under way in response to its recommendations.

39868 (NUREG/CP—0091-Vol.3, pp 1-20) **Application of method to evaluate aging and service wear effects on the low pressure coolant injection mode of the residual heat removal system.** Cleveland, J.W. (SEA Consultants, Inc., San Jose, CA (USA)). Feb 1988. NTIS, PC A 18 - GPO. Order Number TI88006305/JAW. (CONF-8710111—Vol.3).

From 15. water reactor safety information meeting; Gaithersburg, MD, USA (26 Oct 1987).

This report presents a comprehensive approach for evaluating aging effects on systems performance and systems interaction. This approach consists of an interactive modeling technology, N-Square diagram, and computer application. The approach is applied to six nuclear reactor safety related systems: BWR Low Pressure Coolant Injection, Emergency Service Water and Class 1E Power Distribution; and PWR Reactor Trip System, Auxiliary Feedwater System and High Pressure Safety Injection. N-square diagrams are developed to display the system and the interactions (e.g., power, air conditioning, circulating water, etc.) required to complete a plant function at the lowest unit with aging significance (LUWAS). Software is designed for N-square diagram construction and management of the library of data of LUWAS response to age and service stress and aging assessments. The technology and computer application is created to assist power plant operators in the development of inspection, surveillance, and monitoring programs for plant safety systems, support systems and components; and establish the suitability of replacement parts or provide a computer aided engineering system for design and evaluation of a system modification or retrofit. This report presents the N-square diagram developed for the Low Pressure Coolant Injection (LPCI) mode of the BWR residual heat removal system. Technical data have been developed to support the preliminary assessment of aging effects on the system interaction model of the LPCI system.

39869 (NUREG/CP—0091-Vol.3, pp 21-36) **More comprehensive approaches for determining risk sensitivities to component aging.** Vesely, W.E. (Science Applications International Corp., Columbus, OH (USA)). Feb 1988. NTIS, PC A 18 - GPO. Order Number TI88006305/JAW. (CONF-8710111—Vol.3).

From 15. water reactor safety information meeting; Gaithersburg, MD, USA (26 Oct 1987).

As part of the US Nuclear Regulatory Commission's Nuclear Plant Aging Research (NPAR) Program, methods are being developed to evaluate the risk effects of aging. These methods are being developed under the Risk Evaluations of Aging Phenomena (REAP) Project. As part of the effort under REAP, more comprehensive approaches for prioritizing the risk effects of component aging have been developed. These risk prioritization approaches do not have the limitations of previously developed approaches which have been published. Straightforward formulas are obtained which incorporate both the risk importance of the component and the aging effects on the component failure rate. Available Probabilistic Risk Analyses (PRA's) can be utilized to efficiently prioritize systems, components, and aging mechanisms. The linear aging failure rate model is specifically utilized in the general formulas to demonstrate the usefulness and applicability of the approaches. The Calvert Cliffs PRA model is used for illustration.

39870 (NUREG/CP—0091-Vol.3, pp 57-66) **Managing the effects of aging and reliability improvement.** Hall, R.E.; Gunther, W.; Boccio, J.L. Feb 1988. NTIS, PC A 18 - GPO. Order Number TI88006305/JAW. (CONF-8710111—Vol.3).

From 15. water reactor safety information meeting; Gaithersburg, MD, USA (26 Oct 1987).

Over recent years the electric power generating community has acknowledged the importance of the aging process on plant safety and availability. To cope with time-dependent degradation phenomena that can affect active as well as passive components and lead to unacceptable, unanticipated failures requires research into the mechanisms of the aging process, advances in predictive methods for assessing the aging impact on risk and availability, and a better understanding of power plant operations so that strategies for defending against this pervasive stress can be developed. This paper discusses current research advances and presents a framework to aid in the systematic integration of these three needs. As such it is anchored to research being conducted at Brookhaven National laboratory in the areas of plant aging, life extension, reliability, performance indication, and risk assessment.

39871 (NUREG/CP—0091-Vol.3, pp 67-87) **Technical safety issues related to residual life assessment of major LWR components and structures.** Shah, V.N.; MacDonald, P.E.; Burns, J.J. Jr. (Idaho National Engineering Lab., Idaho Falls (USA)). Feb 1988. NTIS, PC A 18 - GPO. Order Number TI88006305/JAW. (CONF-8710111—Vol.3). Contract AC07-76ID01570.

From 15. water reactor safety information meeting; Gaithersburg, MD, USA (26 Oct 1987).

This paper presents an assessment of the time-dependent degradation or aging of selected major light water reactor components and structures. The stressors, possible degradation sites and mechanisms are identified for several major LWR components: pressurized water reactor (PWR) reactor pressure vessels, PWR containment structures, PWR coolant piping and safe ends, PWR surge and spray lines, PWR steam generators, PWR pressurizers, PWR reactor coolant pumps, PWR control rod drive mechanisms, PWR reactor internals, LWR reactor pressure vessel supports, Boiling Water Reactor (BWR) containments, BWR reactor pressure vessels, and BWR recirculation piping. The technical safety issues related to aging and license renewal of these components are also discussed. The general concept of residual life assessment procedures for the major components is presented.

39872 (NUREG/CP—0091-Vol.3, pp 89-107) **Aging assessment of auxiliary feedwater pumps.** Greenstreet, W.L. (Oak Ridge National Lab., TN (USA)). Feb 1988. NTIS, PC A 18 - GPO. Order Number TI88006305/JAW. (CONF-8710111—Vol.3). Contract AC05-84OR21400.

From 15. water reactor safety information meeting; Gaithersburg, MD, USA (26 Oct 1987).

Oak Ridge National Laboratory (ORNL) is conducting aging assessments of auxiliary feedwater pumps to provide recommendations for monitoring and assessing the severity of time-dependent degradation as well as to recommend maintenance and replacement practices. Cornerstones of these activities are the identification of failure modes and causes and ranking of causes. Failure modes and causes of interest are those due to aging and service wear. Design details, functional requirements, and operating experience data were used to identify failure modes and causes and to

rank the latter. Based on this input, potentially useful inspection, surveillance, and condition-monitoring (ISCM) methods that are currently available for use or in the developmental stage were examined and recommendations made. The methods selected are discussed in terms of use and information to be obtained. Relationships between ISCM methods and maintenance practices entered prominently into maintenance recommendations. These recommendations, therefore, embrace predictive as well as corrective and preventative maintenance practices. The specific recommendations are described, inspection details are discussed, and periodic inspection and maintenance interval guidelines are given. Surveillance testing at low-flow conditions is also discussed. It is shown that this type of testing can lead to accelerated aging.

39873 (NUREG/CP—0091-Vol.3, pp 109-113) **Improving motor reliability in nuclear power plants.** Subudhi, M.; Taylor, J. Feb 1988. NTIS, PC A 18 - GPO. Order Number TI88006305/JAW. (CONF-8710111—Vol.3).

From 15. water reactor safety information meeting; Gaithersburg, MD, USA (26 Oct 1987).

Despite the fact that motors are proven to be relatively reliable components and maintenance practices are extensive, motors still experience failures. The operating experience of motors in nuclear power plants clearly indicates that the insulating system and bearing assembly are the dominant failure modes, accounting for almost 70% of the reported failures. Maintaining and monitoring the state of these two subcomponents, using cost effective techniques, could eliminate many untimely failures and thus could improve the overall motor reliability and, hence, the plant safety. This paper discusses the results of the motor study performed under the auspices of the NRC Nuclear Plant Aging Research (NPAR) program. The study included determination of appropriate functional indicators suitable for monitoring the condition of the above-mentioned two subcomponents. This was achieved by performing various bearing and insulation tests on aged motors and evaluating various test procedures.

39874 (NUREG/CP—0091-Vol.3, pp 115-128) **Operating experience and aging assessment of component cooling water systems.** Lofaro, R.; Subudhi, M.; Higgins, J.; Taylor, J. Feb 1988. NTIS, PC A 18 - GPO. Order Number TI88006305/JAW. (CONF-8710111—Vol.3).

From 15. water reactor safety information meeting; Gaithersburg, MD, USA (26 Oct 1987).

Aging of Component Cooling Water (CCW) Systems in nuclear plants has been characterized using the Aging and Life Extension Assessment Program (ALEAP) Systems Level Plan developed by Brookhaven National Laboratory. Failure data from various national data bases were reviewed and analyzed to identify predominant CCW failure modes, causes and mechanisms. Time dependent failure rates for major components were calculated to identify aging trends. Plant specific data were obtained and evaluated to supplement data base results. A computer program (PRAAGE) was developed and implemented to model a typical CCW system design and perform PRA calculations. Time dependent failure rates were input to the program to evaluate the effects on aging on component importance and system unavailability. Changes in both component importance and system unavailability with age were observed and are discussed.

39875 (NUREG/CP—0091-Vol.3, pp 129-151) **Service water system aging assessment - Phase I.** Jarrell, D.B.; Zimmerman, P.W.; Gore, M.L. (Pacific Northwest Lab., Richland, WA (USA)). Feb 1988. NTIS, PC A 18 - GPO. Order Number TI88006305/JAW. (CONF-8710111—Vol.3). Contract AC06-76RL01830.

From 15. water reactor safety information meeting; Gaithersburg, MD, USA (26 Oct 1987).

The Service Water System (SWS) represents the final heat transfer loop between decay heat generated in the nuclear core and the safe dispersal of that heat energy in the environment. It is the objective of this investigation to demonstrate that aging phenomena can be identified and quantified such that aging degradation of system components can be detected and mitigated prior to the reduction of system availability to below an acceptable threshold. The approach used during the Phase I task was to (1) perform a literature search of government and private sector reports which relate to service water, aging related degradation, and potential methodologies for analysis; (2) assemble a data base which contains all the commercial power plants in the US, their Service Water System configuration, characteristics, and water source; (3) obtain and examine the available service water data from large generic data bases, i.e. NPRDS, LER, NPE, inspection reports, and other relevant plant reference data; (4) perform a fault tree analysis of a typical plant service water systems to examine failure propagation and understand specific input requirements of probabilistic risk analyses; (5) develop an in-depth questionnaire protocol for examining the information resource at a power plant which is not available through data base query and visit a central station power plant and solicit the required information; (6) analyze the information obtained from the in-depth plant interrogation and draw contrasts and conclusions with the data base information; (7) utilize the plant information to perform an interim assessment of service water system degradation mechanisms and focus future investigations. This paper addresses the elements of this task plan numbered 1, 3, 6, and 7. The remaining items are detailed in the phase-I report.

39876 (NUREG/CP—0091-Vol.3, pp 169-181) **Seismic fragilities of selected electrical equipment.** Bandyopadhyay, K.K.; Hofmayer, C.H.; Kassir, M.K.; Pepper, S.E. Feb 1988. NTIS, PC A 18 - GPO. Order Number TI88006305/JAW. (CONF-8710111—Vol.3).

From 15. water reactor safety information meeting; Gaithersburg, MD, USA (26 Oct 1987).

In Phase I of the Component Fragility Program, Brookhaven National Laboratory (BNL) has developed a procedure to establish the seismic fragility of nuclear power plant equipment by use of existing test data and demonstrated its application by considering two equipment pieces. In Phase II of the program, BNL has collected additional test data, and has further advanced and is applying the methodology to determine the fragility levels of selected essential equipment categories. The data evaluation of motor control center, switchboard, panelboard and power supply has been completed. Fragility levels have been determined for various failure modes of each equipment class and the deterministic results are presented in terms of test response spectra. In addition, the test data have been analyzed for determination of the respective probabilistic fragility levels. The zero period acceleration and the average spectral acceleration over a frequency range of interest are used as inputs in the statistical analysis. The resulting fragility parameters are presented in terms of a median value, an uncertainty coefficient and a randomness coefficient. Ultimately, each fragility level is expressed in terms of a single descriptor called an HCLPF value corresponding to a high (95%) confidence of a low (5%) probability of failure. The important observations and recommendations for future research work in the fragility area are included in this paper. One of the important needs is to study the applicability of the fragility results to the earlier vintage equipment for which little or no test data exist.

39877 (NUREG/CP—0091-Vol.3, pp 183-199) **Amplification of input motion in a motor control center during seismic fragility testing.** Holman, G.S. (Lawrence Livermore National Lab., CA (USA)). Feb 1988. NTIS, PC A 18 - GPO. Order Number TI88006305/JAW. (CONF-8710111—Vol.3).

From 15. water reactor safety information meeting; Gaithersburg, MD, USA (26 Oct 1987).

At the request of the NRC Office of Nuclear Reactor Regulation, the Lawrence Livermore National Laboratory is performing a study of the structural response of a motor control center (MCC) subjected to high-level seismic fragility testing, including how input motions are amplified by the MCC structure. This study is based on fragility test data developed by LLNL as part of the NRC-sponsored Component Fragility Research Program (CFRP), the purpose of which is to investigate the ability of nuclear power plant components to withstand the effects of large earthquakes. This work is being conducted in two parts. The first, discussed in this report, is a study of kinematic amplification, in other words, amplification defined as the ratio of measured in-cabinet response to measured input motion. This definition of amplification factor (usually based on zero period acceleration or on response at some other specified frequency) is typical of the approach used in design and layout of

cabinets housing electrical devices. The second part of the study, in which amplification is being based on alternate parameters (e.g., power spectral densities of input and response motions) is currently in progress and will not be discussed here in detail.

39878 (NUREG/CP—0091-Vol.3, pp 201-227) **Seismic category I structures program: what we've learned from the TRG (Technical Review Group) structures.** Bennett, J.G.; Farrar, C.R. (Los Alamos National Lab., NM (USA)). Feb 1988. NTIS, PC A 18 - GPO. Order Number TI88006305/JAW. (CONF-8710111—Vol.3).

From 15. water reactor safety information meeting; Gaithersburg, MD, USA (26 Oct 1987).

During the fiscal years up to FY 85, tests on microconcrete scale model shear deformation-dominated structures were performed. The results indicated that these structures responded to seismic excitations with frequencies that were reduced by factors of 2 or more over those calculated based upon an uncracked cross section strength-of-materials approach. During FY 86, a large TRG type structure, referred to as TRG-3, (4-in walls of real concrete, No. 3 rebar, and with about 15 tons of added mass) was tested seismically at the Construction Engineering Research Laboratory (CERL) in Champaign, Illinois. Prior to this test, a 1/4-scale microconcrete model of TRG-3 had been seismically tested at LANL. This scale model, referred to as TRG-1, and its prototype provided information both on reduced stiffness and on the scalability of microconcrete response to the response of structures made from typical concrete and rebar. Also included in the current phase of this program was the quasi-static load cycle testing of TRG type structures. These tests were intended to measure stiffness of the shear walls during well instrumented, controlled tests and to separate the stiffness into shear and bending components. Separation of the stiffness components was aimed at providing more data for identifying a mechanism for the previously observed reductions in stiffness. In addition to the static tests, low-level modal tests were performed on these structures as a further method of identifying their dynamic properties. The results from the testing on the first, third, and fourth TRG structures are summarized and a discussion of these results, in light of what they have learned about the seismic response of the actual low aspect ratio shear wall structure seismic response, is presented.

39879 (NUREG/CP—0091-Vol.3, pp 229-241) **Piping and fitting dynamic reliability program: overview and status.** Guzy, D.J.; DeVita, V.; Hwang, H.; Tagart, S.; Tang, Y.K.; Merz, K. (Nuclear Regulatory Commission (USA)). Feb 1988. NTIS, PC A 18 - GPO. Order Number TI88006305/JAW. (CONF-8710111—Vol.3).

From 15. water reactor safety information meeting; Gaithersburg, MD, USA (26 Oct 1987).

This cooperative EPRI/NRC research program was initiated in 1985 with three main objectives: to identify failure mechanism and failure levels of piping components and systems under dynamic loadings; to provide a data base that will improve their prediction of piping system response and failure due to high level dynamic loads; and to develop an improved and defensible set of piping design rules for inclusion into the ASME Code. The experimental tasks of the Piping and Fitting Dynamic Reliability Program (PFDRP) are now nearing completion. By January 1988, ANCO's forty piping component tests, ETEC's two piping systems tests, and MCL's 140 fatigue-ratcheting specimen tests will have been completed. Also a water hammer pipe systems test is planned and should be completed in early 1988. Analyses and the development of alternative piping design rules will continue until the PFDRP ends in the Spring of 1988. This paper focuses on the results of piping component and systems tests.

39880 (NUREG/CP—0091-Vol.3, pp 243-249) **Seismic design margins program: overview and status.** Murray, R.C.; Guzy, D.J. (Lawrence Livermore National Lab., CA (USA)). Feb 1988. NTIS, PC A 18 - GPO. Order Number TI88006305/JAW. (CONF-8710111—Vol.3).

From 15. water reactor safety information meeting; Gaithersburg, MD, USA (26 Oct 1987).

Most seismic design experts agree that nuclear power plants are capable of withstanding earthquakes much larger than their original design basis without compromising their ability to safety shutdown and remain in a safe shutdown condition. However, only recently through the efforts of the Seismic Design Margins Program, have they had the tools to effectively and efficiently quantify the inherent overall seismic capability of nuclear power plants, and to do so in a way that can be used directly for licensing decisions. The successful completion of the Maine Yankee seismic margins review in March 1987, and the issuance of a NNR Safety Evaluation Report based on this review are major milestones in the seismic evaluation of nuclear power plants. The Seismic Design Margins Program (SDMP) developed a new seismic evaluation methodology to better evaluate the ability of nuclear plants to withstand earthquakes above their design basis level. The approach involves the screening of components based on their importance to safety and their seismic capacity. The products of a margins review are High Confidence of Low Probability of Failure (HCLPF) capacities for components, accident sequences and the plant. The HCLPF value is a lower bound estimate of seismic strength that explicitly considers the confidence in this estimate. Systems analysis is used to determine those plant systems and components that are important contributors to seismic core melt. The paper discusses how the methodology was used in the Maine Yankee review. Ongoing and future SDMP tasks are also mentioned.

39881 (NUREG/CP—0091-Vol.3, pp 251-277) **Vibrational experiments at the HDR: SHAG results and planning for SHAM.** Kot, C.A.; Malcher, L.; Steinhilber, H. (Argonne National Lab., IL (USA)). Feb 1988. NTIS, PC A 18 - GPO. Order Number TI88006305/JAW. (CONF-8710111—Vol.3).

From 15. water reactor safety information meeting; Gaithersburg, MD, USA (26 Oct 1987).

As part of the second phase of vibrational/earthquake investigations at the HDR (Heissdampfreaktor) Test Facility in Kahl/Main, FRG, high-level shaker tests (SHAG) were performed during June and July 1986 by using a coastdown shaker capable of generating 1000 tons of force. The purpose of these experiments was to investigate full-scale structural response, soil/structure interaction, and piping and equipment response under strong excitation conditions. While global safety considerations imposed load limitations, the HDR soil/structure system was nevertheless tested to incipient failure. The performance of pipe support systems was evaluated in as many as seven different multiple-support pipe hanger configurations, ranging from flexible to stiff systems. Data obtained in the tests are used to validate analysis methods. The vibrational/earthquake investigations at the HDR are continuing with the SHAM experiments, planned for the spring of 1988. In these experiments the VKL (Versuchskreislauf) piping loop will be subjected to direct multiple-point excitation at extremely high levels. The objectives are to investigate different pipe support configurations at extreme loading, to establish seismic margins for piping, and to investigation possible failure/plastification modes in an in-situ piping system.

39882 (NUREG/CP—0091-Vol.3, pp 279-293) **Containment penetration system (CPS) valve tests under accident loads.** Crapo, H.S. (Idaho National Engineering Lab., Idaho Falls (USA)). Feb 1988. NTIS, PC A 18 - GPO. Order Number TI88006305/JAW. (CONF-8710111—Vol.3). Contract AC07-76ID01570.

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The results of testing typical US nuclear power plant containment piping penetrations during thermal and mechanical loading are presented. Full-sized hardware, including the containment wall penetration, piping, pipe supports, and isolation valves were subjected to thermal and mechanical loads simulating design basis and severe accident events. The effects of the thermal and mechanical loads on valve leakage and operability and the effect on overall system integrity were studied. All containment systems performed well and showed no loss of function as a result of the thermal and mechanical loads.

39883 (NUREG/CP—0091-Vol.3, pp 295-317) **Light water reactor pressure isolation valve performance.** Corugedo, J.J.; Jeanmougin, N.M.; Neely, H.H. (Energy Technology Engineering Center, Canoga Park, CA (USA)). Feb 1988. NTIS, PC A 18 - GPO. Order Number TI88006305/JAW. (CONF-8710111—Vol.3).

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ETEC completed the Valve Performance Program during Fiscal Year 1987. The Fiscal Year 1987 work focused on leak rate testing and motor signature monitoring of three gate valves ranging in size from four-inch to ten-inch nominal diameter and on investigating innovative methods of detecting loosened check valve internals. The methods experimentally evaluated were acoustic emission monitoring and visual in-service inspection. The test results showed that motor signature monitoring and visual in-service inspection are valuable tools which could be used by nuclear utilities to ascertain the condition of pressure isolation valves.

39884 (NUREG/CP—0091-Vol.3, pp 319-341) **Aging of snubbers in nuclear service: Phase I study results and Phase II plans.** Goodman, R.L.; Bush, S.H.; Page, R.E. (Pacific Northwest Lab., Richland, WA (USA)). Feb 1988. NTIS, PC A 18 - GPO. Order Number TI88006305/JAW. (CONF-8710111—Vol.3). Contract AC06-76RL01830.

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Two major research areas were investigated in the Phase I snubber aging studies. The first area involved a preliminary evaluation of the effects of various aging mechanisms on snubber operation; failure modes of mechanisms were identified and their contributions to aging degradation were assessed relative to other failure modes. The second area involved estimating the efficacy of existing tests and examinations that are intended to determine the effects of aging and degradation. Available data on snubber behavior and operating experience were reviewed, using licensee event reports and other historical data for the 10-year period from 1973 through 1983. Value-impact was considered in terms of (1) exposure of workers to radioactive environments for examination/testing and (2) the cost for expansion of the snubber testing program due to failed snubbers. Results from the Phase I studies identified the need to modify or improve examination and testing procedures to enhance snubber reliability. Based on the results of the Phase I snubber studies, the seals and fluids were identified as the two principal elements affected by aging degradation in hydraulic snubbers. Phase II work, which was initiated in FY 1987, will develop cooperative activities between PNL and operating utilities through the Snubber Utility Group (SNUG), who will work to establish a strong data and experience base for both hydraulic and mechanical snubbers based on actual operating and maintenance history at nuclear power plants. Application guidelines for snubbers will be recommended based on the study results.

39885 (NUREG/CP—0091-Vol.3, pp 343-360) **Valve seismic stability.** Tucek, A.; Josifko, R.; Steinbauer, P. (Sigma Research Institute, Prague (Czechoslovakia)). Feb 1988. NTIS, PC A 18 - GPO. Order Number TI88006305/JAW. (CONF-8710111—Vol.3).

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The preliminary rapid assessment of the seismic stability of valves for nuclear applications is based upon the calculation of the first natural frequency fl and on quasistatic calculations. Based on experience from dynamic research, it is evident that the frequency fl is influenced by the toughness of the spindle, flange joint and by the actuator mass. By modifying the Rayleigh's coefficient the procedure for fl determination was derived. The vibration tests of valves are performed and a theoretical analysis of the mounting rigidity is carried out. The influence could be as much as 20%. The results of overall dynamic assessment and experimental results of valves are summarized.

39886 (NUREG/CP—0091-Vol.3, pp 361-388) **Life assessment of bellows for valves used in nuclear power.** Sima, J.; Bohatec, K.; Zdarek, J. (Sigma Research Institute, Prague (Czechoslovakia)). Feb 1988. NTIS, PC A 18 - GPO. Order Number TI88006305/JAW. (CONF-8710111—Vol.3).

From 15. water reactor safety information meeting; Gaithersburg, MD, USA (26 Oct 1987).

Two types of loading cycles are used for the theoretical and experimental solutions to simulate the loading pattern of bellows in the valve service environment. The ideal shape of the bellow surface is used to calculate the stress amplitudes. Measured characteristics of the bellow wave shape are used for calculations and comparison with the ideal shape. The experimental tests are used for statistical life evaluation and compared with the elastic fatigue analysis and a modified Neuber's analysis. The paper further describes the experimental procedure and equipment.

39887 (NUREG/CP—0091-Vol.3, pp 389-413) **Performance of a piping system and equipment in the HDR simulated seismic experiments.** Steele, R. Jr.; Weidenhamer, G.H. (Idaho National Engineering Lab., Idaho Falls (USA)). Feb 1988. NTIS, PC A 18 - GPO. Order Number TI88006305/JAW. (CONF-8710111—Vol.3).

From 15. water reactor safety information meeting; Gaithersburg, MD, USA (26 Oct 1987).

This paper describes a portion of the analysis and results of the NRC/INEL participation in the SHAG (high-level shaker tests) Seismic Research Program conducted by Kernforschungszentrum Karlsruhe (KFK) at the Heissdampfreaktor (HDR), a decommissioned nuclear reactor. The objective of this activity was to analyze the responses of a piping system and associated line-mounted equipment when subjected to various seismic and hydraulic loadings. The studies compare the influence that piping support system flexibility has on piping system responses. The results of the studies will contribute to the technical basis for assessing the responses of light water reactor (LWR) piping and line-mounted equipment to earthquakes.

39888 (NUREG/CP—0091-Vol.4, pp 1-22) **Uncertainties in modeling and scaling of critical flows and pump model in TRAC-PF1/MOD1.** Rohatgi, U.S.; Yu, W. Feb 1988. NTIS, PC A99/MF A01 - GPO. Order Number TI88007181/JAW. (CONF-8710111—Vol.4).

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The USNRC has established a Code Scalability, Applicability and Uncertainty (CSAU) evaluation methodology to quantify the uncertainty in the prediction of safety parameters by the best estimate codes. These codes can then be applied to evaluate the Emergency Core Cooling System (ECCS). The TRAC-PF1/MOD1 version was selected as the first code to undergo the CSAU analysis for LBLOCA applications. It was established through this methodology that break flow and pump models are among the top ranked models in the code affecting the peak clad temperature (PCT) prediction for LBLOCA. The break flow model bias or discrepancy and the uncertainty were determined by modeling the test section near the break for 12 Marviken tests. It was observed that the TRAC-PF1/MOD1 code consistently underpredicts the break flow rate and that the prediction improved with increasing pipe length (larger L/D). This is true for both subcooled and two-phase critical flows. A pump model was developed from Westinghouse (1/3 scale) data. The data represent the largest available test pump relevant to Westinghouse PWRs. It was then shown through the analysis of CE and CREARE pump data that larger pumps degrade less and also that pumps degrade less at higher pressures. Since the model developed here is based on the 1/3 scale pump and on low pressure data, it is conservative and will overpredict the degradation when applied to PWRs.

39889 (NUREG/CP—0091-Vol.4, pp 23-61) **Uncertainties in modeling and scaling in the prediction of fuel stored energy and thermal response.** Wulff, W. Feb 1988. NTIS, PC A99/MF A01 - GPO. Order Number TI88007181/JAW. (CONF-8710111—Vol.4).

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The steady-state temperature distribution and the stored energy in nuclear fuel elements are computed by analytical methods and used to rank, in the order of importance, the effects on stored energy from statistical uncertainties in modeling parameters, in boundary and in operating conditions. An integral technique is used to calculate the transient fuel temperature and to estimate the uncertainties in predicting the fuel thermal response and the peak clad temperature during a large-break loss of coolant accident. The uncertainty analysis presented here is an important part of evaluating the applicability, the uncertainties and the scaling capabilities of computer codes for nuclear reactor safety analyses. The methods employed in this analysis merit generation attention because of their simplicity. It is shown that the blowdown peak is dominated by fuel stored energy alone or, equivalently, by linear heating rate. Gap conductance, peaking factors and fuel thermal conductivity are the three most important fuel modeling parameters affecting peak clad temperature uncertainty. 26 references.

39890 (NUREG/CP—0091-Vol.4, pp 63-79) **Wear in check valves due to flow induced motion.** Griffith, P.; Sununu, J.C. (Massachusetts Institute of Technology, Cambridge (USA)). Feb 1988. NTIS, PC A99/MF A01 - GPO. Order Number TI88007181/JAW. (CONF-8710111—Vol.4).

From 15. water reactor safety information meeting; Gaithersburg, MD, USA (26 Oct 1987).

Experiments showing the frequency and amplitude of the flow induced motion of the gate for a two and a four inch swing check valve have been performed. The gate motion is due to turbulence in approach flow. The authors have found the dominant turbulent frequency of the approach flow is about half the natural frequency of the valves. The valves appear to be almost critically damped. Because of this, the valves respond almost as they would to a static force of the magnitude characteristic of the turbulent fluctuation in the flow. Both the dimensionless exciting force and the damping ratio have been found to be independent of valve size so the above statements are true for larger valves also. The valve oscillation amplitudes and frequencies are used to calculate the wear at the shaft and at the stop. For an unpegged check valve, such as one of the 10 inch valves which was used at San Onofre, the authors found that shaft wear would amount to .27 inches^3/year and stop wear to .03 inches^3/year.

39891 (NUREG/CP—0091-Vol.4, pp 81-105) **Results of two-phase natural circulation in hot-leg U-bend simulation experiments.** Ishii, M.; Lee, S.Y.; Abou El-Seoud, S. (Argonne National Lab., IL (USA)). Feb 1988. NTIS, PC A99/MF A01 - GPO. Order Number TI88007181/JAW. (CONF-8710111—Vol.4).

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In order to study the two-phase natural circulation and flow termination during a small break loss of coolant accident in LWR, simulation experiments have been performed using two different thermal-hydraulic loops. The main focus of the experiment was the two-phase flow behavior in the hot-leg U-bend typical of B & W LWR systems. The first group of experiments was carried out in the nitrogen gas-water adiabatic simulation loop and the second in the Freon 113 boiling and condensation loop. Both of the loops have been designed as a flow visualization facility and built according to the two-phase flow scaling criteria developed under this program. The nitrogen gas-water system has been used to isolate key hydrodynamic phenomena such as the phase distribution, relative velocity between phases, two-phase flow regimes and flow termination mechanisms, whereas the Freon loop has been used to study the effect of fluid properties, phase changes and coupling between hydrodynamic and heat transfer phenomena. Significantly different behaviors have been observed due to the non-equilibrium phase change phenomena such as the flashing and condensation in the Freon loop. The phenomena created much more unstable hydrodynamic conditions which lead to cyclic or oscillatory flow behaviors.

39892 (NUREG/CP—0091-Vol.4, pp 107-125) **B & W once-through steam generator single tube experiment results.** McCreery, G.E.; Condie, K.G.; Plessinger, M.P. (Idaho National Engineering Lab., Idaho Falls (USA)). Feb 1988. NTIS, PC A99/MF A01 - GPO. Order Number TI88007181/JAW. (CONF-8710111—Vol.4). Contract AC07-76ID01570.

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Experiments are being conducted in an air-water facility that model B & W Once Through Steam Generator (OTSG) heat transfer and fluid flow behavior during auxiliary feedwater (AFW) injection. The OTSG is a single-pass counterflow tube-in-shell heat exchanger in which decay heat removal capability is provided by injection of AFW into the steam generator boiler region. AFW is injected near the top of the bundle, typically through seven penetrating nozzles at the periphery of the bundle. Injection of AFW results in a complex steam-water counterflow situation within the boiler. As AFW is injected it tends to fall downward due to gravity and flow inward due to momentum. Fluid flow is impeded and redistributed by tube support plates (TSP's) spaced along the bundle and by steam flow up the bundle. The single tube experiments described in this paper are the first in a series that examine the basic phenomena of AFW radial and axial flow distribution, tube support plate (TSP) flooding, and tube heat transfer. The succeeding experiments, which are presently underway, address the AFW behavior in an unheated multi-tube (625 tubes) full scale 1/8 sector of the OTSG that includes the top three TSP's. The overall objective of the experiment series is to obtain observations and data of steam generator fluid flow and heat transfer phenomena for the development of RELAP5 and TRAC code models capable of improved predictions. This paper describes data obtained in the single tube experiments conducted to date. The relevant phenomena observed is described and the data analyzed. The analysis is preliminary for the heat transfer data since its analysis employs a computer program that is presently under development.

39893 (NUREG/CP—0091-Vol.4, pp 143-165) **Use of full-scale UPTF data to evaluate scaling of downcomer (ECC bypass) and hot leg two-phase flow phenomena.** Damerell, P.S.; Ehrich, N.E.; Wolfe, K.A. (MPR Associates, Inc., Washington, DC (USA)). Feb 1988. NTIS, PC A99/MF A01 - GPO. Order Number TI88007181/JAW. (CONF-8710111—Vol.4).

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The first Upper Plenum Test Facility (UPTF) Downcomer Separate Effects Test and the UPTF Hot Leg Separate Effects Test provide full-scale data useful for evaluating scaling effects. The downcomer test showed that subcooled ECC (emergency code cooling) penetration down the downcomer at one steam flow was greater than would be predicted from several correlations using the largest available subscale data (1/5 scale by length). This is a favorable result from a licensing standpoint, i.e., actual full-scale performance is better than thought. The multidimensional flow in a large downcomer appears to be a key factor in the better delivery at large scale. The hot leg test showed that saturated water runback to the vessel in a hot leg under CCFL (countercurrent flow limitation) conditions is very close (+/- 5%) to that predicted from the largest subscale tests (1/13 scale by area). This is an encouraging result from the standpoint of scaling. Further, this test shows there is a large margin between typical small break LOCA (loss-of-coolant accident) reflux condensation conditions and CCFL, and that the major scaled small break LOCA scaled integral facilities (PKL, Semiscale, ROSA-IV, FLECHT-SEASET) operated within the hot leg CCFL boundary, even though not necessarily at ideally scaled PWR conditions. Finally, evaluation of these data show that runback of de-entrained water in a hot leg during large break LOCA reflood is likely to occur in typical US PWRs, and the data successfully explain the observation of runback in SCTF (full-height oval hot leg) and the lack of runback in CCTF (scaled height hot leg).

39894 (NUREG/CP—0091-Vol.4, pp 167-194) **Cooldown aspects of the TMI-2 accident.** Theofanous, T.G. (Univ. of California, Santa Barbara (USA)). Feb 1988. NTIS, PC A99/MF A01 - GPO. Order Number TI88007181/JAW. (CONF-8710111—Vol.4).

From 15. water reactor safety information meeting; Gaithersburg, MD, USA (26 Oct 1987).

The cooldown of the TMI-2 reactor vessel due to high pressure injection that occurred at 200 minutes into the accident is reexamined. Flow regimes and condensation heat transfer in the cold legs and downcomer are considered. The presence of noncondensible (hydrogen) and a mechanism leading to its accumulation around the condensation interfaces lead to conclusions that are materially different from those of a previous study that did not consider these effects.

39895 (NUREG/CP—0091-Vol.4, pp 195-201) **Boron mixing in the lower plenum of a BWR.** Theofanous, T.G.; Shabana, E.S.; Vandenbroek, M. (Univ. of California, Santa Barbara (USA)). Feb 1988. NTIS, PC A99/MF A01 - GPO. Order Number TI88007181/JAW. (CONF-8710111—Vol.4).

From 15. water reactor safety information meeting; Gaithersburg, MD, USA (26 Oct 1987).

Current ATWS procedures are rather complicated because of uncertainties regarding the flow behavior of the liquid poison injected into the lower plenum for control. The concern, supported by some old small scale experiments (at General Electric Co.), is that due to strong buoyancy forces the natural circulation flow (less than 30% of rated) would be insufficient to entrain and convect the cold boric acid solution upwards and into the core area. On the other hand, the applicability of these experimental results is also in doubt. This is because Froude number scaling becomes problematic at small scales. The purpose of this work is to bypass such concerns by carrying out a set of experimental simulations at full scale. Such full-scale simulations are practical because of the high degree of compartmentalization of a BWR lower plenum by the control rod guides and the nearly longitudinal flow of coolant in the interstitial spaces. The experimental facility represents a lower plenum slice corresponding to 9 guide tubes in the neighborhood of the injection standpipe (also included at full scale). The structural material is acrylic, allowing full visualization. The base flow is created by recirculating from a 2000 gal capacity (water) tank at velocities up to the full natural circulation strength expected in the reactor. The injection flow consists of a NaCl solution. In addition to visualization the facility is instrumented for mapping out the local/instantaneous concentration (conductivity probes) and velocity (fiber optic laser doppler anemometer)fields. Data from the first round of experiments are presented and initial conclusions regarding stratification potential are drawn.

39896 (NUREG/CP—0091-Vol.4, pp 203-207) **Multi-dimensional RCS natural circulation during a PWR severe accident.** Han, J.T. Feb 1988. NTIS, PC A99/MF A01 - GPO. Order Number TI88007181/JAW. (CONF-8710111—Vol.4).

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This paper summarizes the scope, status, and the preliminary findings of the NRC-sponsored research programs addressing multidimensional natural circulation in the reactor coolant system (RCS) during a PWR station blackout accident in which the auxiliary feedwater to steam generators is also lost (the TMLB' accident).

39897 (NUREG/CP—0091-Vol.4, pp 209-229) **Direct containment heating: is the hazard real.** Lee, T.M. Feb 1988. NTIS, PC A99/MF A01 - GPO. Order Number TI88007181/JAW. (CONF-8710111—Vol.4).

From 15. water reactor safety information meeting; Gaithersburg, MD, USA (26 Oct 1987).

The state of understanding of the DCH issue is reviewed. It appears that neither the analytical tools nor the experimental data that are currently available are adequate to quantify the effects of direct containment heating in a severe reactor accident. It is, therefore, difficult to estimate the hazard of DCH at this time. An estimate of the probable range of containment pressurization due to DCH has been made and discussed here. The NRC research programs are also discussed.

39898 (NUREG/CP—0091-Vol.4, pp 231-246) **United States Nuclear Regulatory Commission research program on molten core debris interactions in the reactor cavity.** Burson, S.B.; Bradley, D.; Brockman, J.; Copus, E.; Powers, D.; Greene, G.; Alexander, C. Feb 1988. NTIS, PC A99/MF A01 - GPO. Order Number TI88007181/JAW. (CONF-8710111—Vol.4).

From 15. water reactor safety information meeting; Gaithersburg, MD, USA (26 Oct 1987).

The NRC research program on Core-Debris/Cavity Interactions comprises two principle elements: (1) an analytical effort focused principally on the development of computer codes needed to predict the potential consequences of risk-significant severe-accident scenarios; and (2) an experimental component to provide insights into the relevant phenomenological processes and to develop the data base necessary for validation of the codes. The analytical activities at Sandia National Laboratories focus primarily on refinement and validation of the CORCON and VANESA codes. Two major experimental activities are also based at SNL. The large scale SURC tests address the thermal-hydraulic phenomena as well as aerosol release associated with prototypical core-melt materials in various types of concrete crucibles, while the WITCH and GHOST experiments are concerned with aerosol generation and radionuclide release phenomena. A program of small scale special-effects tests at Brookhaven National Laboratory is coupled to a concomitant model-development and code-validation activity. In addition, measurements are being made at Battelle Columbus Laboratory to augment the thermochemical data base needed in the VANESA code to permit refined radiological source-term predictions. The current scope and status of this research is reviewed.

39899 (NUREG/CP—0091-Vol.4, pp 247-271) **Uncertainties in hydrogen combustion.** Stamps, D.W.; Wong, C.C.; Nelson, L.S. (Sandia National Labs., Albuquerque, NM (USA)). Feb 1988. NTIS, PC A99/MF A01 - GPO. Order Number TI88007181/JAW. (CONF-8710111—Vol.4).

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Three important areas of hydrogen combustion with uncertainties are identified: high-temperature combustion, flame acceleration and deflagration-to-detonation transition, and aerosol resuspension during hydrogen combustion. The uncertainties associated with high-temperature combustion may affect at least three different accident scenarios: the in-cavity oxidation of combustible gases produced by core-concrete interactions, the direct containment heating hydrogen problem, and the possibility of local detonations. How these uncertainties may affect the sequence of various accident scenarios is discussed and recommendations are made to reduce these uncertainties. 40 references.

39900 (NUREG/CP—0091-Vol.4, pp 273-280) **Quantification of uncertainties in source term estimates for a BWR with Mark I containment.** Khatib-Rahbar, M.; Cazzoli, E.; Davis, R.; Ishigami, T.; Lee, M.; Nourbakhsh, H.; Schmidt, E.; Unwin, S. Feb 1988. NTIS, PC A99/MF A01 - GPO. Order Number TI88007181/JAW. (CONF-8710111—Vol.4).

From 15. water reactor safety information meeting; Gaithersburg, MD, USA (26 Oct 1987).

A methodology for quantification and uncertainty analysis of source terms for severe accident in light water reactors (QUASAR) has been developed. The objectives of the QUASAR program are (1) to develop a framework for performing an uncertainty evaluation of the input parameters of the phenomenological models used in the Source Term Code Package (STCP), and (2) to quantify the uncertainties in certain phenomenological aspects of source terms (that are not modeled by STCP) using state-of-the-art methods. The QUASAR methodology consists of (1) screening sensitivity analysis, where the most sensitive input variables are selected for detailed uncertainty analysis, (2) uncertainty analysis, where probability density functions (PDFs) are established for the parameters identified by the screening stage and propagated through the codes to obtain PDFs for the outputs (i.e., release fractions to the environment), and (3) distribution sensitivity analysis, which is performed to determine the sensitivity of the output PDFs to the input PDFs. In this paper attention is limited to a single accident progression sequence, namely; a station blackout accident in a BWR with a Mark

I containment buildings. Identified as an important accident in the draft NUREG-1150 a station blackout involves loss of both off-site power and DC power resulting in failure of the diesels to start and in the unavailability of the high pressure injection and core isolation coding systems.

39901 (NUREG/CP—0091-Vol.4, pp 281-297) **Preliminary results of aerosol deposition experiments in an engineering-scale ice condenser.** Kannberg, L.D.; Ligotke, M.W.; Eschbach, E.J.; Ross, B.A. (Pacific Northwest Lab., Richland, WA (USA)). Feb 1988. NTIS, PC A99/MF A01 - GPO. Order Number TI88007181/JAW. (CONF-8710111—Vol.4). Contract AC06-76RL01830.

From 15. water reactor safety information meeting; Gaithersburg, MD, USA (26 Oct 1987).

Initial data are reported from engineering-scale tests of aerosol deposition in a small section of an ice condenser typical of that used in certain pressurized water reactors (PWRs). The data will be used to validate a computer code (ICEDF) that predicts aerosol deposition in PWR ice condensers. The code was developed to assess the effectiveness of one type of engineered safety feature (ESR). Results of the three tests completed show that decontamination factors (DF = aerosol mass flux entering divided by aerosol mass flux leaving) from 1 to 3 are achieved in the test section depending on aerosol, gas flow, and ice conditions. A measured DF of 1.0 was obtained when no ice was present in the test section, the aerosol aerodynamic mass median diameter (AMMD) was 6 μm, and gas flow rate was low, 0.03 m^3/s. The computer code, ICEDF, calculated a DF of 1.4 for similar conditions. When ice was present in the system and the same aerosol and gas flow conditions were used, the measured DF increased to 2.1 while the ICEDF computed DF ranged from 2.6 to 1.9. The DF increased dramatically when the gas flow rate was increased to 0.23 m^3/s and had a steam mole fraction of 0.44. Including the zone upstream of the test section where considerable cooling occurs, a measured DF of 10 or more was observed. The test section DF declined during this test from 3.6 to less than 1.0, as ice was melted out. Particle growth from 2.4 μm (AMMD) to 9.1 μm (AMMD) was observed in the test section during this test, probably due to steam condensation. Test temperature data and flow visualization studies indicate complex gas flow with stable large-scale flow recirculation.

39902 (NUREG/CP—0091-Vol.4, pp 299-323) **Results of the four PBF severe fuel damage tests.** Osetek, D.J. (Idaho National Engineering Lab., Idaho Falls (USA)). Feb 1988. NTIS, PC A99/MF A01 - GPO. Order Number TI88007181/JAW. (CONF-8710111—Vol.4). Contract AC07-76ID01570.

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Four in-pile severe fuel damage tests have been conducted in the Power Burst Facility as part of the US Nuclear Regulatory Commission's (USNRC) Severe Accident and Source Term Research Program. The tests included 1-m long bundles of PWR fuel pins and simulated the thermal-hydraulic and fuel damage conditions of a severe core damage accident. Tests were run with both low and high burnup fuel, low and high coolant flow and with slow and rapid cooldown. One test included Ag-In-Cd control rods. The various types of fuel damage that occurred in the four tests are presented and the measured hydrogen generation, fission product release, and aerosol behavior are described. The principal benefits of the test program have been to improve the USNRC's severe accident analysis capability. Some of the computer models affected by the test results are discussed in the paper.

39903 (NUREG/CP—0091-Vol.4, pp 325-348) **MIST test results.** Gloudemans, J.R.; Birmingham, D.P. (Babcock & Wilcox Co., Lynchburg, VA (USA)). Feb 1988. NTIS, PC A99/MF A01 - GPO. Order Number TI88007181/JAW. (CONF-8710111—Vol.4).

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The multiloop integral system test facility (MIST) was part of a jointly-sponsored program to generate integral system data for code benchmarking. The MIST facility, a scaled model of a B & W-designed lowered-loop plant, was extensively instrumented. Small-Break Loss of Coolant Accidents (SBLOCA), HPI-PORV cooling, steam generator tube ruptures, and the effects of non-condensible gases and pump operation were tested. A number of noteworthy interactions that occurred during the SBLOCA tests are summarized herein. The results of three SBLOCA tests that demonstrate an important system response, the ability of the system to adjust to imbalanced boundary conditions, are presented.

39904 (NUREG/CP—0091-Vol.4, pp 349-371) **Observations of UMCP 2x4 loop test result simulating B and W power plants behavior.** Hsu, Y.Y.; Almenas, K.; Di Marzo, M.; Unal, C.; Wang, Z.Y. (Univ. of Maryland, College Park (USA)). Feb 1988. NTIS, PC A99/MF A01 - GPO. Order Number TI88007181/JAW. (CONF-8710111—Vol.4).

From 15. water reactor safety information meeting; Gaithersburg, MD, USA (26 Oct 1987).

Three areas are covered in this report: (a) the thermal-hydraulics behavior of the loop during liquid inventory depletion transients as a result of SBLOCA; (b) the integral and global approach to the facility scaling; and (c) the repeatability of the tests. Phenomenological description of the thermal-hydraulic events that take place during a simulated Small Break Loss of Coolant Accident is presented. Two types of conditions are present. The process was found to be controlled by inventory. Thus inventory scaling can be used as an alternative to time scaling in describing the event sequence. Such scaling is much simpler than the conventional hydrodynamic scaling. The causes producing variability between the test data of identical test runs in a multi-loop thermal-hydraulic system can be divided into two categories. The categories can be distinguished by the distribution of the experimental variation, namely: (1) Gaussian and (2) Bifurcation. The first category encompasses that which could be called the standard variations of experimental data. The second category of deviations to arise when a system under certain conditions can be in two alternate but energetically equivalent states.

39905 (NUREG/CP—0091-Vol.4, pp 373-386) **LOBI-MOD2 small break LOCA and special transients experimental program: status and future plans.** Piplies, L.; Addabbo, C. (Commission of the European Communities, Ispra (Italy)). Feb 1988. NTIS, PC A99/MF A01 - GPO. Order Number TI88007181/JAW. (CONF-8710111—Vol.4).

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The LOBI-MOD2 (LWR Off-normal Behavior Investigations) experimental program is outlined with emphasis on specific program objectives, significant achievements and future plants. The general structure of and the framework in which the research program is carried out are firstly described. The status of the experimental program and short term plans are then presented; within this context the methodology underlying the establishment of the LOCA and Special Transients Test Matrices is discussed. Finally, system code assessment and improvement activities which complement the experimental program are briefly highlighted.

39906 (NUREG/CP—0091-Vol.4, pp 387-412) **TRAC-PF1/MOD1 calculations and data comparisons for MIST small break loss-of-coolant accidents with scaled 10 cm^2 and 50 cm^2 breaks.** Steiner, J.L.; Siebe, D.A.; Boyack, B.E. (Los Alamos National Lab., NM (USA)). Feb 1988. NTIS, PC A99/MF A01 - GPO. Order Number TI88007181/JAW. (CONF-8710111—Vol.4).

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Los Alamos National Laboratory is a participant in the Integral System Test (IST) program initiated in June 1983 for the purpose of providing integral system test data on specific issues/phenomena relevant to post-small-break loss-of-coolant accidents (SBLOCAs), loss of feedwater and other transients in Babcock & Wilcox (B & W) plant designs. The Multi-Loop Integral System Test (MIST) facility is the largest single component in the IST program. MIST is a 2 x 4 (2 hot legs and steam generators, 4 cold legs and reactor-coolant pumps) representation of lowered-loop reactor systems of the B & W design. It is a full-height, full-pressure facility with 1/817 power and volume scaling. Two other experimental facilities are included in the IST program: test loops at the University of Maryland, College Park and at Stanford Research Institute.

The objective of the IST tests is to generate high-quality experimental data to be used for assessing thermal-hydraulic safety computer codes. Efforts are underway at Los Alamos to assess TRAC-PF1/MOD1 against data from each of the IST facilities. Calculations and data comparisons for TRAC-PF1/MOD1 assessment have been completed for two transients run in the MIST facility. These are the MIST nominal test, Test 3109AA, a scaled 10 cm^2 SBLOCA and Test 320201, a scaled 50 cm^2 SBLOCA. Only MIST assessment results are presented in this paper.

39907 (NUREG/CP—0091-Vol.4, pp 413-436) **Two-phase scaling distortions.** Wang, Z.Y.; Almenas, K. (Univ. of Maryland, College Park (USA)). Feb 1988. NTIS, PC A99/MF A01 - GPO. Order Number TI88007181/JAW. (CONF-8710111—Vol.4).

From 15. water reactor safety information meeting; Gaithersburg, MD, USA (26 Oct 1987).

A methodology is developed to evaluate the limitations of the similarity laws currently used for reactor thermal-hydraulics. It is shown that the currently used similarity laws should be used with caution. On the other hand, although the scalability of the system simulation code remains to be investigated, the code is a scaling methodology that has much more potential than the similarity laws. In the paper, the distortions generated by scaling laws are called Scaling Law Distortions (SLD). It is argued that the SLD may not be equal to the actually existing Total distortions (TD). The difference between the SLD and TD represent the limitations of the similarity laws in scaling application. Because in reality the TD cannot be experimentally obtained, the TD is approximated by employing the system simulation code calculations. This is because the system simulation code is the only analytical tool that can be simulate a system characterized by complex cause-and-effect interrelationships between flow phenomena, whereas the similarity laws (based on only a single set of dimensionless numbers) do not consider these interrelationships. It is shown that an analysis regarding scaling adequacy based on TD's can at times reverse the analysis based on SLD's. The vertical hot leg of a B & W type Pressurized Water Reactor is chosen as the demonstration problem. The current RELAP5/MOD2 code is used to calculate the TD's.

39908 (NUREG/CP—0091-Vol.4, pp 437-461) **Results of 0.5% PWR small break LOCA tests in ROSA-IV LSTF break location parameter test series.** Tasaka, K.; Kukita, Y.; Kumamaru, H.; Yonomoto, T.; Suzuki, M.; Koizumi, Y. (Japan Atomic Energy Research Institute, Ibaraki). Feb 1988. NTIS, PC A99/MF A01 - GPO. Order Number TI88007181/JAW. (CONF-8710111—Vol.4).

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The effects of break location on a PWR small-break LOCA with failure of the high pressure injection (HPI) system were studied experimentally using the Large Scale Test Facility of the ROSA-IV Program. The LSTF is a 1/48 volumetrically-scaled simulator of a Westinghouse-type 4-loop (3423 MWt) PWR. Five tests were conducted for a break area of 0.5% of the volumetrically-scaled PWR cold leg cross-sectional area (equivalent approximately to a 2-in. diameter break in a PWR). In these tests the break was located at the pressure vessel lower plenum, cold leg, hot leg, pressure vessel upper head, and the top of the pressurizer. HPI and the auxiliary feedwater were assumed unavailable. In all of these tests the core was uncovered and heated up at a primary pressure higher than the secondary pressure. The heatup was terminated when the core level was recovered by initiating HPI manually. The break location had a significant influence on the time available before the initiation of the core uncovery.

39909 (NUREG/CP—0091-Vol.4, pp 463-480) **Core liquid level depression in 5% small break LOCAs: an investigation using subscale data.** Schultz, R.R.; Motley, F.E.; Stumpf, H.; Watkins, J.C.; Chen, Y.S. (EG & G Idaho, Inc., Idaho Falls (USA)). Feb 1988. NTIS, PC A99/MF A01 - GPO. Order Number TI88007181/JAW. (CONF-8710111—Vol.4). Contract AC07-76ID01570.

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Core heatup has been shown to be possible, during the course of small break loss-of-coolant accidents (SBLOCAs), even when sufficient inventory is present to fully cover the rods with a two-phase mixture. Such behavior occurs when steam, trapped between the loop seal and the core inventory, moves coolant out of the core barrel region and uncovers the rod upper elevations. The net result is core liquid level depression. Core liquid level depression and subsequent core heatups are investigated using subscale data from the ROSA-IV Program's 1/48-scale Large Scale Test Facility (STF) and the 1/1705-scale Semiscale facility. The depression phenomena and factors which influence the minimum core level are described and illustrated using examples from the data. Analyses conducted using the TRAC-PF1/MOD1 version 12.7 thermal-hydraulic code are also described and summarized.

39910 (NUREG/CP—0091-Vol.4, pp 481-506) **Evaluation of operational safety at Babcock and Wilcox plants.** Hanson, D.J.; Blackman, H.S.; Wheatley, P.D.; Meyer, O.R.; Nelson, W.R.; Davis, C.B. (EG & G Idaho, Inc., Idaho Falls (USA)). Feb 1988. NTIS, PC A99/MF A01 - GPO. Order Number TI88007181/JAW. (CONF-8710111—Vol.4).

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A methodology was developed to assess the operational performance of nuclear power plants through an integration of thermal-hydraulic, human factors, and risk analysis techniques. This methodology was applied to evaluate the effectiveness of plant systems and operator actions in lessening the severity of selected transients for Babcock and Wilcox (B & W) plants. Comparisons were also performed to assess differences in operational performance capabilities and limitations between selected Combustion Engineering, Westinghouse, and B & W plants. For the selected B & W plant, the results show the probability that an operating crew would not respond within the times available (the non-response probability) is estimated to be relatively small for the three transients studied. Results also show a strong correlation between operator performance and the influence of eight performance shaping factors (PSFs). Comparison of results from the Oconee, Calvert Cliffs, and H. B. Robinson plants indicate that the likelihood operators would take the proper actions to return Oconee to a safe stable state is not judged to be significantly different than the likelihood operators at Calvert Cliffs or H. B. Robinson would recover their plants for the transients investigated. The validity of this conclusion depends on the assumption that the performance shaping factors at all three plants are essentially equivalent. Recommendations are made that influence performance shaping factors positively and thereby influence operator performance positively.

39911 (NUREG/CP—0091-Vol.4, pp 507-532) **UPTF experiment: first integral test with combined ECC injection.** Weiss, P.A.; Hertlein, R.J. (Siemens KWU, Erlangen (West Germany)). Feb 1988. NTIS, PC A99/MF A01 - GPO. Order Number TI88007181/JAW. (CONF-8710111—Vol.4).

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The first integral test was run in the Upper Plenum Test Facility (UPTF) - a 1:1 representation of a PWR primary system. A double-ended cold leg break under evaluation model-type (EM) conditions with combined ECC injection was simulated in this test. The focus was on the thermohydraulic phenomena in the upper plenum and downcomer as well as in the cold and hot legs under transient conditions. Of special interest were the thermohydraulic interactions between the above mentioned regions.

39912 (NUREG/CP—0091-Vol.4, pp 533-547) **UPTF test results: first downcomer CCF test.** Hertlein, R.J.; Weiss, P.A. (Siemens KWU, Erlangen (West Germany)). Feb 1988. NTIS, PC A99/MF A01 - GPO. Order Number TI88007181/JAW. (CONF-8710111—Vol.4).

From 15. water reactor safety information meeting; Gaithersburg, MD, USA (26 Oct 1987).

The first downcomer countercurrent flow test was run in the Upper Plenum Test Facility - a 1:1 representation of a PWR primary system. In this downcomer separate effect test the simultaneous steam up or two-phase mixture up and water downflow phenomena were investigated.

39013 (NUREG/CP—0091-Vol.4, pp 549-558) **Multi-dimensional effect found in SCTF reflood tests for US/J PWR.** Adachi, H.; Iguchi, T.; Iwamura, T.; Ohnuki, A.; Abe, Y.; Akimoto, H.; Okubo, T.; Murao, Y. (Japan Atomic Energy Research Institute, Ibaraki). Feb 1988. NTIS, PC A99/MF A01 - GPO. Order Number TI88007181/JAW. (CONF-8710111—Vol.4).

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Multi-dimensional core thermal-hydraulic behavior in the reflooding process of a large break loss-of-coolant accident was studied with Slab Core Test Facility (SCTF) for pressurized water reactors with cold leg injection type emergency core cooling system, which are operated mainly in the US and Japan. The most remarkable finding is enhancement of heat transfer in the high power bundles due to radial power distribution effect. The effect always reduces the turnaround temperature of the high power bundles. Increase in heat transfer coefficient in the high power bundles can be predicted with an empirical correlation proposed in this paper as function of local radial power ratio and radial peaking factor.

39014 (NUREG/CP—0091-Vol.4, pp 561-583) **Analysis results from the Los Alamos 2D/3D program.** Boyack, B.E.; Cappiello, M.W.; Harmony, S.C.; Shire, P.R.; Siebe, D.A. (Los Alamos National Lab., NM (USA)). Feb 1988. NTIS, PC A99/MF A01 - GPO. Order Number TI88007181/JAW. (CONF-8710111—Vol.4).

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Los Alamos National Laboratory is a participant in the 2D/3D program. Activities conducted at Los Alamos National Laboratory in support of 2D/3D program goals include analysis support of facility design, construction, and operation; provision of boundary and initial conditions for test-facility operations based on analysis of pressurized water reactors; performance of pretest and post-test predictions and analyses; and use of experimental results to validate and assess the single- and multi-dimensional, nonequilibrium features in the Transient Reactor Analysis Code (TRAC). During fiscal year 1987, Los Alamos conducted analytical assessment activities using data from the Slab Core Test Facility, the Cylindrical Core Test Facility, and the Upper Plenum Test Facility. Finally, Los Alamos continued work to provide TRAC improvements. In this paper, Los Alamos activities during fiscal year 1987 are summarized; several significant accomplishments are described in more detail to illustrate the work activities at Los Alamos.

39015 (NUREG/CP—0091-Vol.4, pp 585-607) **Analysis of UPTF test 11 (hot leg CCF) with a full-range drift-flux model.** Sonnenburg, H.G. (Gesellschaft fuer Reaktorsicherheit, Garching (West Germany)). Feb 1988. NTIS, PC A99/MF A01 - GPO. Order Number TI88007181/JAW. (CONF-8710111—Vol.4).

From 15. water reactor safety information meeting; Gaithersburg, MD, USA (26 Oct 1987).

At GRS a full-range drift-flux model has been developed and verified. This model has been developed on the basis of both the drift-flux theory and the envelope theory. The resulting model equation predicts the relative velocity for horizontal pipes and for inclined pipes. The model equation is implemented into the GRS system code ATHLET. The UPTF test 11 (hot leg CCF test) produces two-phase flow in a full-scale hot leg simulator relative to a KWU reactor. Therefore, the measurement of flow parameters in that facility procures a valuable basis in order to assess the full-scale performance of the ATHLET code. A good agreement between measured and predicted flow parameters has been reached. Even the typical flow behavior at the onset of flooding is correctly predicted by the ATHLET code. The drastic change in water level heights which occurs when countercurrent flow limitation (CCFL) is reached could be explained by the code. Therefore, the ATHLET code can be regarded as a tool to analyze details of CCFL phenomena. By means of comparative calculations the influence of the Hutze (an elliptically shaped ECC inlet device) on CCFL is investigated. Based on these calculations it is shown that this influence is less than 10% in steam mass flow rate.

39016 (NUREG/CP—0091-Vol.5, pp 1-106) **Nuclear safety research: responsive industry results.** Rubio, A.; Loewenstein, W.B.; Oehlberg, R. (Electric Power Research Institute, Palo Alto, CA (USA)). Feb 1988. NTIS, PC A20/MF A01. Order Number TI88006492/JAW. (CONF-8710111—Vol.5).

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EPRI's nuclear safety research program made a number of technical advances this past year. EPRI has completed a study of common cause failure, developed software for plant reliability and safety, studied reliability-centered maintenance, studied the consequences of steam generator tube rupture, completed the study of eastern seismic activity, looked at piping design improvements, qualified RETRAN for simulator applications, conducted intermediate-scale molten corium-concrete interaction tests and completed a mechanistic code to calculate core melt. A major owner's group experimental effort on hydrogen combustion has been completed, characterizing hydrogen combustion behavior in BWR6 Mark III containments. Within the US, EPRI is involved in many national and international collaborative efforts such as the TREAT STEP and the MIST B & W tests, the OECD LOFT program and the LACE, ACE, and Marviken aerosol-behavior experimental programs. Also, EPRI is participating the NRC's important Severe Fuel Damage Program. This paper reviews EPRI's nuclear safety research program in the context of this new transitional phase and how it is meeting the everyday challenges of commercial nuclear power. 158 references.

39017 (NUREG/CP—0091-Vol.5, pp 107-139) **Recent MAAP developments.** Fuller, E.L.; Ritzman, R.L.; Mendoza, Z.T.; Sherry, R.R.; Henry, R.E. (Electrical Power Research Institute, Palo Alto, CA (USA)). Feb 1988. NTIS, PC A20/MF A01. Order Number TI88006492/JAW. (CONF-8710111—Vol.5).

From 15. water reactor safety information meeting; Gaithersburg, MD, USA (26 Oct 1987).

In this paper, recent MAAP (Modular Accident Analysis Program) developments are described. In particular, the most recent enhancements made both by EPRI and IDCOR are discussed. The status of the independent verification and validation project is presented. Finally, the results of a comparison between MAAP 3.0 and the Source Term Code Package (STCP) on the Peach Bottom plant are given and discussed.

39018 (NUREG/CP—0091-Vol.5, pp 141-166) **Ground motion characterization based on the linear and non-linear behavior of structures and equipment.** Sewell, R.T.; Cornell, C.A.; Toro, G.R.; McGuire, R.K.; Singh, A.; Kassawara, R.P. (Risk Engineering Inc., Golden, CO (USA)). Feb 1988. NTIS, PC A20/MF A01. Order Number TI88006492/JAW. (CONF-8710111—Vol.5).

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Results of recent study examining the effects of earthquake ground motion on models representative of nuclear power plant (NPP) structures and equipment is summarized. Motion characterizations based on nonlinear structure response (as opposed to linear response spectra characterizations) are first defined, and their significance is discussed. Next, equipment behavior is examined for four categories of structure-equipment response: linear-linear (i.e., linear structure, linear equipment), nonlinear-linear, linear-nonlinear, and nonlinear-nonlinear. Equipment response components for each of these cases are identified and their characteristics are examined. Relevance of this work in addressing aspects of the seismic performance of NPPS is mentioned, particularly regarding the effects of structure nonlinearity on equipment response, and the influence of small-magnitude, high-PGA, high-frequency, short-duration ground motions (typified by some recent recordings in eastern North America) on typical NPP structures and equipment. Simple understanding and analytical methods are presented that allow one to quickly assess the effects of given ground motion characteristics on structure and equipment behavior. 24 references.

39919 (NUREG/CP—0091-Vol.5, pp 167-184) **Piping system damping study.** Tang, H.T.; Hadjian, A.H. (Electric Power Research Institute, Palo Alto, CA (USA)). Feb 1988. NTIS, PC A20/MF A01. Order Number TI88006492/JAW. (CONF-8710111—Vol.5).

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Piping System damping research at EPRI is briefly described in this paper. The focus of the research is to derive a set of technically defensible piping system damping values which can be included in Appendix N, Section III, Division I of the ASME Boiler and Pressure Vessel Code for piping dynamic analysis. Engineering judgments and regression analyses were employed to derive damping functional relationship by first establishing a uniform experimental data base, then de-aggregating the data to sort out significant contributing parameters and finally performing regression analysis. Results to date show support density, support type, insulation, frequency, attached equipment, diameter and weight are significant parameters controlling damping. A formal recommendation to ASME and guidelines of using recommended damping in various piping analysis methods remains to be accomplished.

39920 (NUREG/CP—0091-Vol.5, pp 187) **Expert system applications to nuclear plant for enhancement of productivity and performance.** Sun, B.; Cain, D.; Naser, J.; Colley, R.; Hirota, N. (Electric Power Research Institute, Palo Alto, CA (USA)). Feb 1988. NTIS, PC A20/MF A01. Order Number TI88006492/JAW. (CONF-8710111—Vol.5).

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Expert systems, a major essence of the artificial intelligence (AI) technology, are referred to as computer software and hardware systems which are designed to capture and emulate the knowledge, reasoning, judgment, and to store the expertise of humans. Two parallel efforts are being performed at the Electric Power Research Institute (EPRI) to help the electric utility industry take advantage of the expert system technology. The first effort is the development of expert system building tools which are tailored to electric utility industry applications. The second effort is the development of expert system application prototypes. These two efforts complement each other. The application development tests the tools and identifies additional tool capabilities which are required. The tool development helps define the applications which can be successfully developed. This paper summarizes a number of research projects which are being performed at EPRI in both the areas of expert system building tool development and expert system applications to operations and maintenance. The AI technology as demonstrated by the development is being established as a credible technological tool for the electric utility industry. A challenge to transferring the expert systems technology to the utility industry is to gain utility users' acceptance of this modern information technology. To achieve successful technology transfer, the technology developers need to (1) understand the problems which can be addressed successfully using AI technology, (2) involve with users throughout the development and testing phases, and (3) demonstrate the benefits of the technology by the users.

39921 (NUREG/CP—0091-Vol.5, pp 189-192) **RELAP5/MOD2 development.** Miller, C.S. (EG & G Idaho, Inc., Idaho Falls (USA)). Feb 1988. NTIS, PC A20/MF A01. Order Number TI88006492/JAW. (CONF-8710111—Vol.5). Contract AC07-76ID01570.

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Status of the RELAP5 code development program at the Idaho National Engineering Laboratory (INEL) is discussed. While RELAP5/MOD2 is undergoing international assessment, emphasis is on user support and code maintenance. User support is in response to user inquiries and a PC-based newsletter service is provided. The FY-1987 activities discussed include the development of a detailed model description document, a software tool for formalized tracking of the configuration of the code, the migration of the code to both larger and smaller computers, and the feedback of user experiences into a development version to become RELAP5/MOD3, which will be the next official released version of the code. Future plans discuss some of the models to be modified and added to RELAP5/MOD3.

39922 (NUREG/CP—0091-Vol.5, pp 193-199) **Status of the TRAC-BWR program.** Weaver, W.L. III; Johnsen, G.W. (EG & G Idaho, Inc., Idaho Falls (USA)). Feb 1988. NTIS, PC A20/MF A01. Order Number TI88006492/JAW. (CONF-8710111—Vol.5).

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The Transient Reactor Analysis Code for Boiling Water Reactors (TRAC-BWR) is being developed and maintained at the Idaho National Engineering Laboratory (INEL) for the Division of Accident Evaluation, Office of Nuclear Regulatory Research of the US Nuclear Regulatory Commission (USNRC). The objective of this development is to provide the USNRC with a detailed, best estimate, efficient computer code for the analysis of postulated accidents and transients in boiling water reactor (BWR) systems. This program is unique among advanced code development projects in that it focuses on the hardware, thermal-hydraulics, and heat transfer phenomena that distinguish BWR systems and their response in transients. In addition to providing a best estimate analysis capability for BWR systems, the code can also be used to address current licensing concerns such as anticipated transients without scram (ATWS) or the small break loss-of-coolant accident (SBLOCA). It also provides analytical support the USNRC experimental safety programs. Work during FY-1987 has focused on improvements to the hydrodynamic models; completion of programming changes for increased portability, maintainability, and machine independence; preparation of a detailed report describing the constitutive relations and special process models such as the CCFL and critical flow models; and implementation of the hybrid Courant limit violating numerics in the three-dimensional VESSEL component. These improvements are described.

39923 (NUREG/CP—0091-Vol.5, pp 201-224) **JRC Ispra results from assessment of RELAP5/MOD2 on the basis of LOBI test data.** Staedtke, H.; Kolar, W. (Commission of the European Communities, Ispra (Italy)). Feb 1988. NTIS, PC A20/MF A01. Order Number TI88006492/JAW. (CONF-8710111—Vol.5).

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In the framework of the LOBI project, various RELAP5 code versions have been used extensively for test design calculations, pre-test predictions and post-test analysis. Important results from assessment calculations and code sensitivity studies performed in 1986/87 with RELAP5/MOD2 are presented in this paper. The assessment cases include Small Break LOCA and Special Transients Experiments. From the comparison of measured and predicted parameters, conclusions are drawn on the prediction capabilities of RELAP5/MOD2. Specific problems observed with regard to the automatic time-step control, flow regime selection, interphase heat transfer and break mass flow calculations are analyzed. The significance of these deficiencies are described and recommendations are given for the improvement of the RELAP5 code.

39924 (NUREG/CP—0091-Vol.5, pp 225-249) **Overview of code maintenance activities: TRAC-PF1/MOD1.** Jenks, R.P.; Spore, J.W. (Los Alamos National Lab., NM (USA)). Feb 1988. NTIS, PC A20/MF A01. Order Number TI88006492/JAW. (CONF-8710111—Vol.5).

From 15. water reactor safety information meeting; Gaithersburg, MD, USA (26 Oct 1987).

To support the objectives of the International Code Assessment and Applications (ICAP) program, Los Alamos provided several user support and code maintenance activities for TRAC-PF1/MOD1. Code deficiencies identified through this process were removed by developing new models or improved models for the next version of the TRAC code. Los Alamos has responded to the needs of the ICAP program by providing quality state-of-the-art software in support of ICAP and USNRC safety-analysis objectives.

39925 (NUREG/CP—0091-Vol.5, pp 251-270) **UK experience with RELAP5/MOD2.** Ardron, K.H.; Hall, P.C. (Central Electricity Generating Board, Gloucester (England)). Feb 1988. NTIS, PC A20/MF A01. Order Number TI88006492/JAW. (CONF-8710111—Vol.5).

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RELAP5/MOD2 is being used in the UK for analysis of small LOCA and pressurized transients in the Sizewell B PWR. To support this application and gain familiarity with the code, the CEGB and UKAEA have analyzed a number of integral and separate effects tests with RELAP5/MOD2. Several reports on this work have been sent to USNRC under a UK/USNRC bilateral agreement. This paper presents a review of UK experience with RELAP5/MOD2 since the code was received in the UK in February 1985. Calculations are described of small LCOA and pressurized transient experiments in the LOFT and LOBI test facilities, and boil-down tests in the UKAEA THETIS facility. Code calculations are also compared with data on pull-through/entrainment effects in two-phase flow in an off-take branch connected to a horizontal pipe containing stratified flow. The code has generally been found to perform well in the calculations attempted so far, and appears to represent a considerable improvement over earlier versions of RELAP5 in respect of stability, running speed, mass conservation errors, and accuracy. The modeling difficulties identified in the UK studies have been: defects in the horizontal stratification entrainment model, used to calculate discharge from a side branch connected to a horizontal pipe in which there is stratified flow; deficiencies in critical flow calculation when there is separated flow in the volume upstream of the break. Some calculations with modified code versions containing improved models are described to illustrate the deficiencies.

39926 (NUREG/CP—0091-Vol.5, pp 271-305) **Application of RELAP5/MOD2 for determination of accident management procedures.** Stoop, P.M.; van den Bogaard, J.P.A.; Woudstra, A.; Koning, H. (Netherlands Energy Research Foundation, Petten). Feb 1988. NTIS, PC A20/MF A01. Order Number TI88006492/JAW. (CONF-8710111—Vol.5).

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This paper presents the results of a number of severe accident transient analyses, which have been performed for the two Nuclear Power Plants (NPP's) under operation in the Netherlands, using the RELAP5/MOD2 computer program. The two NPP's include a natural circulation BWR of the early General Electric design, and a PWR of the Kraftwerk Union design. The transients considered include Station Blackout, ATWS, primary Feed-and-Bleed (PWR), and IB-LOCA (BWR). All transients considered may potentially end-up in a core melt situation. The influence of operator action on the course of the transient events has been investigated, especially with respect to the possibility to depressurize the plant before core melt actually occurs. The results of the analyses serve as input for a safety evaluation of both NPP's which is presently being performed as part of the post-Chernobyl activities in the Netherlands.

39927 (NUREG/CP—0091-Vol.5, pp 307-323) **Validation of TRAC-PF1/MOD1 against experiment LP-02-6 of the OECD-LOFT series.** Lopez, J.V.; Blanco, J.; Rivero, J.; Alonso, A. (Madrid Polytechnical Univ., (Spain)). Feb 1988. NTIS, PC A20/MF A01. Order Number TI88006492/JAW. (CONF-8710111—Vol.5).

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Experiment LP-02-6 of the LOFT-OECD series has been analyzed with TRAC-PD2 and TRAC-PF1. Steady state, pretest and post-test calculations with TRAC-PD2 were reported in the 14th WRSIM (1986). Modifications of the code were proposed to predict better rod temperature profile and other parameters. In this report the experiment is analyzed with a frozen version of TRAC-PF1/MOD1 to serve as an ICAP exercise. The result of this work is compared with the old results from TRAC-PD2 before being modified. Although TRAC-PF1 renders results closer to experiment, still it does not reproduce correctly the rod temperature profile. No effort has been put into introducing new correlations for the minimum film boiling temperature as it was done, with positive results, for TRAC-PD2.

39928 (NUREG/CP—0091-Vol.5, pp 325-333) **Status of the RELAP5 user guidelines.** Jacobson, J.L.; Hanson, R.G. (EG & G Idaho, Inc., Idaho Falls (USA)). Feb 1988. NTIS, PC A20/MF A01. Order Number TI88006492/JAW. (CONF-8710111—Vol.5).

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This paper presents an overview of a RELAP5 User Guidelines document which is currently being developed under the sponsorship of the US Nuclear Regulatory Commission (USNRC) at the Idaho National Engineering Laboratory (INEL). The RELAP5 User Guidelines will provide insight for proper code use for specific applications and specific guidance relative to nodalization of nuclear power plants and experimental facilities based on a standard nodalization philosophy. 33 references.

39929 (NUREG/CP—0091-Vol.5, pp 335-351) **Merits and limits of code assessment based on full scale plant data.** Stubbe, E.J. (Tractebel, Brussels (Belgium)). Feb 1988. NTIS, PC A20/MF A01. Order Number TI88006492/JAW. (CONF-8710111—Vol.5).

From 15. water reactor safety information meeting; Gaithersburg, MD, USA (26 Oct 1987).

Among the questions that need be answered by the thermal hydraulic assessment program is the scalability of the physical models used in best estimate advanced computer codes. This problem needs special attention if the basis for plan licensing in the area of LOCA and ECCS shifts from evaluation models to best estimate models, as is the tendency today. The database for the physical models in the advanced thermal hydraulic codes is largely based on small scale separate effect tests and integral scaled down facilities. There is a growing interest in performing counterpart tests in order to verify the scalability of the constitutive equations in function of an accepted nodalization scheme and an applied numerical solution concept for different best estimate codes. The outcome of such counterpart tests can yield some evidence of the scalability over a range of scales varying between 1/1600 and 1/48, such that the extrapolation to full scale remains questionable. In an attempt to close this scaling gap for specific code models, full scale separate effect tests offer a good opportunity. However such facilities are very expensive and require artificial boundary conditions which may mask some dominating phenomena induced by loop components and their mode of operation. There remains then the question to what extent full scale plant data could be used to try to close the scaling gap of the experimental evidence? The proposed validation matrices contain indeed very few plant transients, and this for different reasons. This paper tries to compile the different advantages and disadvantages that full scale plants offer for code assessment, and presents a practical exercise on a DOEL-4 transient to highlight those points.

39930 (NUREG/CP—0091-Vol.5, pp 353-375) **UK experience with TRAC/PF1-MOD1 in modeling small break LOCA integral tests.** Richards, C.G. (United Kingdom Atomic Energy Authority, Winfrith). Feb 1988. NTIS, PC A20/MF A01. Order Number TI88006492/JAW. (CONF-8710111—Vol.5).

From 15. water reactor safety information meeting; Gaithersburg, MD, USA (26 Oct 1987).

The TRAC-PF1/MOD1 code has been assessed in the UK against LOFT tests LP-SB-1, LP-SB-2 and LP-SB-3, and LOBI tests A2-81 (ISP18), BL-02 and BL-12. The paper summarizes the main conclusions from the TRAC analysis of each test. The adequacy of TRAC for modeling these tests is then considered in terms of completeness (does TRAC contain models of the main process?), accuracy, quality (e.g. speed, robustness), and usability. One model omission, namely the representation of branching flow, and a number of areas requiring improvement or further assessment, are identified. This list of areas needing attention includes some aspects of TRAC which make life difficult for the code user even though it is possible to obtain reasonable results with the existing code version.

39931 (NUREG/CP—0091-Vol.5, pp 377-398) **Experience with use of RELAP5/MOD2 and TRAC-PF1/MOD1 in the Federal Republic of Germany.** Winkler, F.J.; Wolfert, K. (Siemens KWU, Erlangen (West Germany)). Feb 1988. NTIS, PC A20/MF A01. Order Number TI88006492/JAW. (CONF-8710111—Vol.5).

From 15. water reactor safety information meeting; Gaithersburg, MD, USA (26 Oct 1987).

FRG's participation in ICAP with SIEMENS (KWU) and GRS as executing agents of the BMFT is primarily to establish internationally assessed and approved computer codes for accident analysis of LWR's. In SIEMENS (KWU) RELAP 5/MOD 2 is used as the main thermohydraulic code for LOCA-analysis over the entire transient range. Therefore more emphasis is placed on the updated FGR-ICAP matrix on assessing RELAP 5/MOD 2 for large break LOCA-analysis. In KWU and GRS TRAC-PF1 is used mainly for multidimensional PWR-benchmark studies and research in particular for UPTF pre- and post-test analysis. The updated FRG-ICAP matrix includes 42 specified assessment studies with 8 yet to be defined. In the paper the types of analysis performed in the FRG at KWU and GRS using RELAP-5/MOD 2 and TRAC-PF1 are explained. Examples of results from RELAP-5 and TRAC-PF1 calculation are also presented and significant findings discussed.

39932 (NUREG/CP—0091-Vol.5, pp 399-413) **Phenomena identification and ranking tables (PIRT) for LBLOCA.** Shaw, R.A.; Dimenna, R.A.; Larson, T.K.; Wilson, G.E. (EG & G Idaho, Inc., Idaho Falls (USA)). Feb 1988. NTIS, PC A20/MF A01. Order Number TI88006492/JAW. (CONF-8710111—Vol.5).

From 15. water reactor safety information meeting; Gaithersburg, MD, USA (26 Oct 1987).

The US Nuclear Regulatory Commission is sponsoring a program to provide validated reactor safety computer codes with quantified uncertainties. The intent is to quantify the accuracy of the codes for use in best estimate licensing applications. One of the tasks required to complete this program involves the identification and ranking of thermal-hydraulic phenomena that occur during particular accidents. This paper provides detailed tables of phenomena and importance ranks for a PWR LBLOCA. The phenomena were identified and ranked according to perceived impact on peak cladding temperature. Two approaches were used to complete this task. First, a panel of experts identified the physical processes considered to be most important during LBLOCA. A second team of experienced analysts then, in parallel, assembled complete tables of all plausible LBLOCA phenomena, regardless of perceived importance. Each phenomenon was then ranked in importance against every other phenomenon associated with a given component. The results were placed in matrix format and solved for the principal eigenvector. The results as determined by each method are presented in this report.

39933 (NUREG/CP—0091-Vol.5, pp 415-436) **TRAC-PF1/MOD1 uncertainty quantification for LBLOCA blowdown PCT.** Katsma, K.R.; Dimenna, R.A.; Wilson, G.E. (EG & G Idaho, Inc., Idaho Falls (USA)). Feb 1988. NTIS, PC A20/MF A01. Order Number TI88006492/JAW. (CONF-8710111—Vol.5). Contract AC07-76ID01570.

From 15. water reactor safety information meeting; Gaithersburg, MD, USA (26 Oct 1987).

Over the past few years, an effort has been made to define and quantify the uncertainty in NRC supported computer programs designed to predict the response of nuclear power plants to hypothetical accident scenarios. This paper describes a method to assess the many mathematical models, correlations, and empiricisms used in the codes, and to determine the uncertainty in their predictive capability due to scale effects, lack of data base, variability in the input or thermo-physical data, plant conditions, etc. The Code Scaling, Applicability, and Uncertainty evaluation methodology is a structured process to analyze the combination of these models and correlations and their numerical representation of interrelated thermo-hydraulic processes that take place during a transient event. It provides criteria to determine their ability to accurately represent the significant phenomena that occur during the transient, and to quantify the uncertainty in the final calculated results. The initial application of the methodology to a large break loss-of-coolant accident is described.

39934 (NUREG/CP—0091-Vol.5, pp 437-464) **Thermal stratification tests in horizontal feedwater pipelines.** Wolf, L.; Schygulla, U.; Geiss, M.; Hansjosten, E. (Kernforschungszentrum Karlsruhe GmbH, Frankfurt/Main (West Germany)). Feb 1988. NTIS, PC A20/MF A01. Order Number TI88006492/JAW. (CONF-8710111—Vol.5).

From 15. water reactor safety information meeting; Gaithersburg, MD, USA (26 Oct 1987).

In recent years a particular form of crack formation has occurred in a number of BWRs and PWRs at the internal surfaces of horizontal feedwater piping upstream of the reactor pressure vessels or steam generators, respectively. To obtain more detailed and consistent sets of experimental data for fluid and inside/outside pipe wall surface temperatures to assess the effects for load combinations resulting from thermal shock, stratification and striping phenomena, an experimental test program, abbreviated TEMR, T33, has been performed at the large-scale HDR-facility under close to realistic conditions. This paper summarizes some of the major experimental findings from out of 25 experiments representing typical BWR and PWR conditions. Informations are also provided about the mixing layer height, thermal characteristics and the heat transfer coefficient. A first assessment of the comparison between blind pre-test predictions using simple engineering models and sophisticated, multi-dimensional codes and experimental data is provided.

39935 (NUREG/CP—0091-Vol.6, pp 1-26) **Effectiveness and safety aspects of selected decontamination methods for LWRs: the recontamination experience.** Duce, S.W. (EG & G Idaho, Inc., Idaho Falls (USA)). Feb 1988. NTIS, PC A 12 - GPO. Order Number TI88006636/JAW. (CONF-8710111—Vol.6). Contract AC07-76ID01570.

From 15. water reactor safety information meeting; Gaithersburg, MD, USA (26 Oct 1987).

During the years 1983 to 1986 chemical decontaminations of primary recirculation system piping was performed at many boiling water reactors in the US. At most facilities the recirculation piping was replaced following the chemical decontamination. At a few facilities the piping was inspected for cracks and weld overlays were applied to any identified cracks. This paper presents information on the recontamination of these recirculation systems following one to two fuel cycles.

39936 (NUREG/CP—0091-Vol.6, pp 27-41) **Effect of decontamination on aging processes and considerations for life extension.** Diercks, D.R. (Argonne National Lab., IL (USA)). Feb 1988. NTIS, PC A 12 - GPO. Order Number TI88006636/JAW. (CONF-8710111—Vol.6). Contract W-31-109-ENG-38.

From 15. water reactor safety information meeting; Gaithersburg, MD, USA (26 Oct 1987).

The basis for a recently initiated program on the chemical decontamination of nuclear reactor components and the possible impact of decontamination on extended-life service is described. The incentives for extending plant life beyond the present 40-year limit are discussed, and the possible aging degradation processes that may be accentuated in extended-life service are described. Chemical decontamination processes for nuclear plant primary systems are summarized with respect to their corrosive effects on structural alloys, particularly those in the aged condition. Available experience with chemical cleaning processes for the secondary side of PWR steam generators is also briefly considered. Overall no severe materials corrosion problems have been found that would preclude the use of these chemical processes, but concerns have been raised in several areas, particularly with respect to corrosion-related problems that may develop during extended service. 31 references.

39937 (NUREG/CP—0091-Vol.6, pp 43-59) **Potential problems associated with ion-exchange resins used in the decontamination of light water reactor systems.** Soo, P.; Adams, J.W.; Kempf, C.R. (Brookhaven National Lab., Upton, NY (USA)). Feb 1988. NTIS, PC A 12 - GPO. Order Number TI88006636/JAW. (CONF-8710111—Vol.6).

From 15. water reactor safety information meeting; Gaithersburg, MD, USA (26 Oct 1987).

During a typical decontamination event, ion-exchange resin beds are used to remove corrosion products (radioactive and non-radioactive) and excess decontamination reagents from waste streams. The spent resins may be solidified in a binder, such as cement, or sealed in a high-integrity container (HIC) in order to meet waste stability requirements specified by the Nuclear Regulatory Commission. Lack of stability of low-level waste in a shallow land burial trench may lead to trench subsidence, enhanced water infiltration and waste leaching, which would result in accelerated transport of radionuclides and the complexing agents used for decontamination. The current program is directed at investigating safety problems associated with the handling, solidification and containerization of decontamination resin wastes. The three tasks currently underway include freeze-thaw cycling of cementitious and vinyl ester-styrene forms to determine if mechanical integrity is comprised, a study of the corrosion of container materials by spent decontamination waste resins, and investigations of resin degradation mechanisms.

39938 (NUREG/CP—0091-Vol.6, pp 61-66) **Power reactor decommissioning projects in the Federal Republic of Germany.** Miller, R.L. (Westinghouse Hanford Co., Richland, WA (USA)). Feb 1988. NTIS, PC A 12 - GPO. Order Number TI88006636/JAW. (CONF-8710111—Vol.6).

From 15. water reactor safety information meeting; Gaithersburg, MD, USA (26 Oct 1987).

During 1987, three power reactor decommissioning projects in the Federal Republic of Germany (FRG) were visited. The three projects were the Kernkraftwerk Lingen (KWL), the Kernforschungszentrum Karlsruhe Niederaichbach (KKN), and the Kerkraftwerk RWE-Bayernwerk Block A (KRBA). This paper briefly discusses the status of each of these projects and includes some observations on the FRG decommissioning methodology and philosophy.

39939 (NUREG/CP—0091-Vol.6, pp 67-88) **Radionuclide source term measurements for power reactor decommissioning assessment.** Robertson, D.E.; Thomas, C.W. (Pacific Northwest Lab., Richland, WA (USA)). Feb 1988. NTIS, PC A 12 - GPO. Order Number TI88006636/JAW. (CONF-8710111—Vol.6). Contract AC06-76RL01830.

From 15. water reactor safety information meeting; Gaithersburg, MD, USA (26 Oct 1987).

Studies are in progress to characterize the residual radionuclide concentrations, distribution, and inventories in materials and components from nuclear power reactors at the time of decommissioning. These studies are providing essential information for assessing the radiological safety, technology, waste disposal, and environmental assurance associated with commercial reactor decommissioning. The decommissioning of Shippingport Station provides the first opportunity, following the establishment of NRC rules on commercial decommissioning and waste disposal, to characterize and assess the residual radiological conditions during the actual decommissioning of a nuclear power station. Preliminary measurements have indicated that the residual activation product concentrations in primary loop systems at Shippingport Station are, on the average, 5 to 50 times lower than observed at commercial stations. In addition, no significant concentrations of fission products and transuranic radionuclides are present in the residual radioactive materials. Studies are also in progress to assess the problem associated with decommissioning and disposal of highly neutron activated components from within commercial reactor pressure vessels and spent fuel assembly hardware. This assessment is being accomplished through a sampling and analysis program which examines neutron activation of pressure vessel steel, stainless steel, inconel and zircaloy components of fuel assembly hardware. This assessment will include a comparison of empirical activation product measurements with predicted levels using established codes to evaluate the accuracy and identify any shortcoming in the predictive calculation methodology.

39940 (NUREG/CP—0091-Vol.6, pp 89-105) **Severe accident management in the United States.** Sheron, B.W. Feb 1988. NTIS, PC A 12 - GPO. Order Number TI88006636/JAW. (CONF-8710111—Vol.6).

From 15. water reactor safety information meeting; Gaithersburg, MD, USA (26 Oct 1987).

This paper discusses the concept of severe accident management, the role it is expected to play if a severe accident were to occur, and the approach the NRC expects to take in ensuring the implementation of severe accident management programs in operating US plants. The paper describes in-vessel and ex-vessel management, human factors and organizational considerations, and the NRC research program.

39941 (NUREG/CP—0091-Vol.6, pp 107-131) **Severe accident management on French PWRs.** Duco, J.; Brisbois, J.; Queniart, D. (Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France)). Feb 1988. NTIS, PC A 12 - GPO. Order Number TI88006636/JAW. (CONF-8710111—Vol.6).

From 15. water reactor safety information meeting; Gaithersburg, MD, USA (26 Oct 1987).

A probabilistic approach was introduced in France in the early seventies to define safety provisions against external impacts (aircraft crashes and risks related to an industrial environment). In 1977 an overall safety objective - more a target than a mandatory value - was issued by the safety authority in terms of an upper probability limit for having unacceptable consequences. Following that ruling, the utility was required to prove that the loss of the redundant safety-related systems would meet the safety objective. The TMI-2 accident enhanced the interest in confused situations in which possible multiple equipment failure and/or inappropriate previous actions of the operators impede the implementation of any of the existing event-oriented procedures. In such situations, the objective becomes to avoid core-melt by any means available; this is the goal of the U1 symptom-oriented procedure. Whenever a core-melt occurs, provisions have been made to delay and limit the consequences of the loss of the containment: the U2, U4, and U5 ultimate procedures - the latter providing a venting of the containment through a filtration system - have been elaborated for that purpose. Emergency management procedures, whether event- or symptom-oriented, need a significant R and D effort in order to be elaborated and checked; such an effort resulted in the achievement of the physical code CATHARE and the integral test facility BETHSY, which are both used for adjusting the procedures. For the case of an emergency, a nationwide organization has been set up to provide the plant operator with a redundant technical expertise, to help him save his plant or mitigate the radiological consequences of a core-melt.

39942 (NUREG/CP—0091-Vol.6, pp 133-147) **German accident management program.** Hicken, E.F.; Erven, U.; Kersting, E. (Gesellschaft fuer Reaktorsicherheit, Garching (West Germany)). Feb 1988. NTIS, PC A 12 - GPO. Order Number TI88006636/JAW. (CONF-8710111—Vol.6).

From 15. water reactor safety information meeting; Gaithersburg, MD, USA (26 Oct 1987).

In the FRG extensive analyses of possible Accident Management measures are performed. The presented results of these analyses show that there is a great potential for the operators to avoid core melt by flexible use of existing or slightly modified systems. Decisions have been made on Accident Management measures to prevent containment failures due to overpressurization of the containment (filtered venting for PWR's and BWR's); to prevent containment failures due to hydrogen burn (inerting BWR containments); and increasing battery capacity for 2-3 hours. Measures under discussion are, e.g., catalytic foils to prevent an increase of hydrogen concentration in PWR containments; secondary and primary bleed and feed for PWR's; and diverse use of systems to restore the core coolant inventory and decay heat removal (e.g. by fire fighting system). The objective of all theses measures is a further decrease of core melt frequency and to limit considerably the consequences in case of a core melt. The main future activities will be the development and validation of accident management measures as well as a more detailed analysis of the system capabilities. In addition, the appropriateness of instrumentation will be further assessed and diagnostic tools improved. An appropriate procedure description and training will be prepared.

39943 (NUREG/CP—0091-Vol.6, pp 149-153) **Regulatory perspective on accident management issues.** Barrett, R.J. Feb 1988. NTIS, PC A 12 - GPO. Order Number TI88006636/JAW. (CONF-8710111—Vol.6).

From 15. water reactor safety information meeting; Gaithersburg, MD, USA (26 Oct 1987).

Effective response to reactor accidents requires a combination of emergency operations, technical support and emergency response. The NRC and industry have actively pursued programs to assure the adequacy of emergency operations and emergency response. These programs will continue to receive high priority. By contrast, the technical support function has received relatively little attention from NRC and the industry. The results from numerous PRA studies and the severe accident programs of NRC and the industry have yielded a wealth of insights on prevention and mitigation of severe accidents. The NRC intends to work with the industry to make these insights available to the technical support staffs through a combination of guidance, training and periodic drills.

39944 (NUREG/CP—0091-Vol.6, pp 155-173) **TMI-2 accident scenario development.** Tolman, E.L.; Kuan, P.; Broughton, J.M. (EG & G Idaho Inc., Idaho Falls (USA)). Feb 1988. NTIS, PC A 12 - GPO. Order Number TI88006636/JAW. (CONF-8710111—Vol.6). Contract AC07-76ID01570.

From 15. water reactor safety information meeting; Gaithersburg, MD, USA (26 Oct 1987).

A best-estimate accident scenario describing the important mechanisms that controlled the core damage progression during the TMI-2 accident has been described in previous papers and reports. Several important questions were identified in these documents for which additional analysis and/or data are necessary to develop an adequate understanding. This paper summarizes recent analytical work relating to: (a) configuration of the degraded core based on interpreting the source range monitor data, (b) the coolability of the upper core debris bed, (c) potential crust failure mechanisms and the interaction of the molten core material with the reactor vessel coolant, and (d) potential reactor vessel damage.

39945 (NUREG/CP—0091-Vol.6, pp 175-198) **TMI-2 core bore examination results.** Olsen, C.S.; Akers, D.W.; McCardell, R.K. (EG & G Idaho Inc., Idaho Falls (USA)). Feb 1988. NTIS, PC A 12 - GPO. Order Number TI88006636/JAW. (CONF-8710111—Vol.6). Contract AC07-76ID01570.

From 15. water reactor safety information meeting; Gaithersburg, MD, USA (26 Oct 1987).

Examinations are being performed on samples obtained from the lower portion of the TMI-2 reactor core as part of the TMI-2 Sample Acquisition and Examination Program. This paper presents preliminary results of visual examinations, the gamma spectrometry analyses performed on the intact core bores, and the metallurgical examinations. These examinations indicate significant core damage effects on the distribution of core materials and fission products in the lower reactor core including the substantial relocation and segregation of some fission products (e.g., Sb-125 and Ru-106).

39946 (NUREG/CP—0091-Vol.6, pp 199-209) **Microstructural and microchemical characterization of samples from the TMI-2 core.** Neimark, L.A.; Strain, R.V.; Sanecki, J.E.; Jackson, W.D. (Argonne National Lab., IL (USA)). Feb 1988. NTIS, PC A 12 - GPO. Order Number TI88006636/JAW. (CONF-8710111—Vol.6).

From 15. water reactor safety information meeting; Gaithersburg, MD, USA (26 Oct 1987).

Samples of materials from various regions of the TMI-2 reactor core and vessel have been examined at Argonne National Laboratory with a variety of microanalytical techniques. The purpose of these examinations is to characterize the microstructure and microchemistry of the materials so that their origin could be determined, their fission-product content evaluated, and their role in the accident scenario assessed. Macroscopic and microscopic composition inhomogeneities in melted fuel from different reactor locations indicate different cooling rates and solidification temperatures. The mobility of molten fuel could have been enhanced by a low temperature eutectic in the Fe-Cr-O system. Stainless steel-clad Ag-In-Cd control rods could have failed from a eutectic reaction between the Zircaloy guide tubes and the cladding. Significant concentrations of fission products were not found, but their release from the fuel did not appear to be enhanced by gas-generated channels along grain boundaries.

39947 (NUREG/CP—0091-Vol.6, pp 211-250) **Analysis of fission product release behavior during the TMI-2 accident.** Petti, D.A.; Adams, J.P.; Anderson, J.L.; Hobbins, R.R. (EG & G Idaho, Inc., Idaho Falls (USA)). Feb 1988. NTIS, PC A 12 - GPO. Order Number TI88006636/JAW. (CONF-8710111—Vol.6). Contract AC07-76ID01570.

From 15. water reactor safety information meeting; Gaithersburg, MD, USA (26 Oct 1987).

An analysis of fission product release during the Three Mile Island Unit 2 (TMI-2) accident has been initiated to provide an understanding of fission product behavior that is consistent with both the best estimate accident scenario and fission product results from the ongoing sample acquisition and examination efforts. First principles fission product release models are used to describe release from intact, disrupted, and molten fuel. Conclusions relating to fission product release, transport, and chemical form are drawn. 35 references.

39948 (NUREG/CP—0092) **Proceedings of the seminar on Leak-Before-Break: Progress in regulatory policies and supporting research.** Kashima, K.; Wilkowski, G.M. (eds.). (Nuclear Regulatory Commission, Washington, DC (USA); Battelle Columbus Div., OH (USA)). Mar 1988. 537p. (CONF-8705277—). NTIS, PC A03/MF A01 - GPO;1. Order Number TI88900623/JAW.

From Seminar on leak-before-break: progress in regulatory policies and supporting research; Tokyo, Japan (14 May 1987).

The third in a series of international Leak-Before-Break (LBB) Seminars supported in part by the US Nuclear Regulatory Commission was held at TEPCO Hall in the Tokyo Electric Power Company's (TEPCO) Electric Power Museum on May 14 and 15, 1987. The seminar updated the international policies and supporting research on LBB. Attendees included representatives from regulatory agencies, electric utility representatives, fabricators of nuclear power plants, research organizations, and university professors. Regulatory policy was the subject of presentations by Mr. G. Arlotto (US NRC, USA), Dr. H. Schultz (GRS, W. Germany), Dr. P. Milella (ENEA-DISP, Italy), Dr. C. Faidy, P. Jamet, and S. Bhandari (EDF/Septen, CEA/CEN, and Framatome, France), and Mr. T. Fukuzawa (MITI, Japan). Dr. F. Nilsson presented revised nondestructive inspection requirements relative to LBB in Sweden. In addition, several papers on the supporting research programs discussed regulatory policy. Questions following the presentations of the papers focused on the impact of various LBB policies or the impact of research findings. Supporting research programs were reviewed on the first and second day by several participants from the US, Japan, Germany, Canada, Italy, Sweden, England, and France.

39949 (NUREG/CR—4674-Vol.6) **Precursors to potential severe core damage accidents, 1986: A status report: Appendixes D, E, and F.** Minarick, J.W.; Harris, J.D.; Austin, P.N.; Cletcher, J.W.; Hagen, E.W. (Oak Ridge National Lab., TN (USA)). May 1988. 313p. (ORNL/NOAC—232-Vol.6). NTIS, PC A14;3. Order Number TI88010505/JAW.

Reactor plant operational events for 1986 were selected for documentation as precursors to potential severe core damage based on the selection criteria described in this report. These events are documented here. For each precursor, a precursor description sheet and a conditional core-damage calculation are included. The precursor description sheet briefly describes the event sequence, provides plant and event data pertinent to the evaluation, and documents the modeling considerations and decisions made. Included with the conditional core-damage calculations are individual sequences probabilities for the more significant core-damage (CD), core-vulnerability (CV), and anticipated-transient-without-scram (ATWS) sequences; identification of dominant sequences for each end state; and a listing of the branch probabilities and frequencies utilized. Individual sequences were lised if their probability was >0.03 times the probability of the dominant sequence for each end state. Licensee event reports associated with the precursors and operational event listings are also provided.

39950 **(NUREG/CR—4881) Fission product release characteristics into containment under design basis and severe accident conditions.** Nourbakhsh, H.P.; Khatib-Rahbar, M.; Davis, R.E. (Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research; Brookhaven National Lab., Upton, NY (USA)). Mar 1988. Contract AC02-76CH00016. 105p. (BNL-NUREG—52059). NTIS, PC A06 - GPO. Order Number TI88010887/JAW.

A detailed review of the radiological release estimates for light water reactor accident sequences is presented as a basis for development of a simplified approach for prediction of characteristics of radiological releases into containments under design basis and severe accident conditions for both Pressurized Water Reactors (PWRs) and Boiling Water Reactors (BWRs). Resulting source term estimates are also compared with parallel results using the Source Term Code Package (STCP) methodology.

39951 **(NUREG/CR—4971) Results of Semiscale Mod-2C feedwater and steam line break (S-FS) experiment series: Main steam line break accident experiments.** Boucher, T.J. (EG and G Idaho, Inc., Idaho Falls (USA)). Mar 1988. Contract AC07-76ID01570. 110p. (EGG—2516). NTIS, PC A06/MF A01 - GPO. Order Number TI88008581/JAW.

This report presents the results of two experiments conducted in the Semiscale Mod-2C facility which simulated main steam line break accidents at high pressure and temperature. Tests S-FS-1 and S-FS-2 simulated double-ended offset shears of the main steam line downstream and upstream, respectively, of the flow restrictor. Initial and boundary conditions were scaled from, and compounding failures and assumptions simulated, those conditions utilized for Final Safety Analysis Report (FSAR) calculations. Primary and secondary thermal-hydraulics responses are characterized (including local secondary convective heat transfer), and the influence of the break size or locations on the responses is discussed. The limiting of primary-to-secondary heat transfer by conduction heat transfer is shown to produce a trend of increased primary cooling with decreased break size, pointing out the need for further analysis for smaller break sizes. The degree of conservatism inherent in FSAR separator performance and break size and location assumptions is shown to be questionable, and the FSAR assumption of a loss of offsite power is shown to be nonconservative. The effectiveness of the recovery operations in regaining and maintaining control of the system is addressed; and main steam line break issues, including the minimum primary fluid temperatures estimated for a full-scale PWR plant, are discussed based on the results of the experiments. Finally, based on the results of the analysis, conclusions are drawn and recommendations are made for further utilization of the data. Future thermal-hydraulic computer code calculations are also considered.

39952 **(NUREG/CR—5000) Methodology for uncertainty estimation in NUREG-1150 (Draft): Conclusions of a review panel.** Kouts, H.; Cornell, A.; Farmer, R.; Hanauer, S.; Rasmussen, N. (Nuclear Regulatory Commission, Washington, DC (USA); Brookhaven National Lab., Upton, NY (USA)). Dec 1987. Contract AC02-76CH00016. 18p. (BNL-NUREG—52119). NTIS, PC A03/MF A01 - GPO;1. Order Number TI88011714/JAW.

A review has been undertaken by a panel of experts, of the methodology for estimation of uncertainty in severe accident risk resulting from accidents to nuclear power plants as presented in the Draft NUREG-1150 report. This report provides detailed dicussions and conclusions resulting from this review process.

39953 **(NUREG/CR—5021-Vol.1) User's guide for PRISM (Plant Risk Status Information Management System) Arkansas Nuclear One-Unit 1: Volume 1, Program for inspectors.** Campbell, D.J.; Guthrie, V.H.; Kirchner, J.R.; Kirkman, J.Q.; Paula, H.M.; Ellison, B.C.; Dycus, F.M.; Farquharson, J.A.; Flanagan, G.F. (Oak Ridge National Lab., TN (USA)). Mar 1988. Contract AC05-84OR21400. 191p. (ORNL/TM—10604-Vol.1). NTIS, PC A09/MF A01 - GPO;1. Order Number TI88008925/JAW.

This user's guide is a two-volume document designed to teach NRC inspectors and NRC regulators how to access probabilistic risk assessment information from the two Plant Risk Status Information Management System (PRISIM) programs developed for Arkansas Nuclear One -- Unit One (ANO-1). This document, Volume 1, describes how the PRA information available in Version 1.0 of PRISIM is useful for planning inspections. Using PRISIM, inspectors can quickly access PRA information and use that information to update risk analysis results, reflecting a plant's status at any particular time. Both volumes are stand-alone documents, and each volume presents several sample computer sessions designed to lead the user through a variety of PRISIM applications used to obtain PRA-related information for monitoring and controlling plant risk.

39954 **(NUREG/CR—5042-Suppl.1) Evaluation of external hazards to nuclear power plants in the United States: Seismic hazard.** Prassinos, P.G. (Lawrence Livermore National Lab., CA (USA)). Apr 1988. 53p. (UCID—21223-Suppl.1). NTIS, PC A04/MF A01 - GPO. Order Number TI88008753/JAW.

As part of the research program supporting the implementation of the NRC Policy Statement on Severe Accidents, the Lawrence Livermore National Laboratory (LLNL) has performed a study of the risk of core damage to nuclear power plants in the United States due to seismic initiated events. The broad objective has been to gain an understanding of whether or not seismic events are among the major potential accident initiators that may pose a threat of severe reactor core damage or of large radioactive release to the environment from the reactor. The analysis was based on two figures-of-merit, one based on core damage frequency and the other based on the frequency of large radioactive releases. Using these two figures-of-merit as evaluation criteria, it has been possible to ascertain that the risk from seismic initiated accidents is an important contributor to overall risk for the US nuclear power plants studies.

39955 **(NUREG/CR—5072) Decay heat removal using feed-and-bleed for US pressurized water reactors.** Loomis, G.G.; Cozzuol, J.M. (Nuclear Regulatory Commission, Washington, DC (USA). Div. of Reactor and Plant Systems; EG and G Idaho, Inc., Idaho Falls (USA)). Jun 1988. 41p. (EGG—2526). NTIS, PC A03/MF A01 - GPO. Order Number TI88012341/JAW.

As part of a United States Nuclear Regulatory Commission (USNRC) evaluation of current decay heat removal methods, the adequacy of feed-and-bleed decay heat removal has been assessed for United States pressurized water reactor (USPWRs). Use of feed-and-bleed for decay heat removal becomes necessary in a pressurized water reactor (PWR) system if there is a loss of steam generator heat sink capability. The feed-and-bleed technique involves passing hot fluid out of the primary system through a pressurized power operated relief valve (PORV), while simultaneously feeding the primary system with subcooled high pressure injection system (HPIS) flow, charging flow, or both. This document summarizes the results of available experimental and analytical work that has been performed to investigate the thermal hydraulic phenomena associated with the feed-and-bleed technique. The results are then synthesized into a statement of adequacy of the feed-and-bleed technique as a means of decay heat removal. It is concluded that feed-and-bleed can be a viable alternative form of decay heat removal for USPWRs, but that successful use of feed-and-bleed is contingent upon the existence and use of procedures for its implementation, as well as upon the specified of plant design.

39956 **(NUREG/CR—5105) Response margins investigation of piping dynamic analyses using the independent support motion method and PVRC [Pressure Vessel Research Committee] damping.** Bezler, P.; Wang, Y.K.; Reich, M. (Brookhaven National Lab., Upton, NY (USA)). Mar 1988. Contract AC02-76CH00016. 391p. (BNL-NUREG—52137). NTIS, PC A17/MF A01 - GPO;1. Order Number TI88010551/JAW.

An evaluation of Independent Support Motion (ISM) response spectrum methods of analysis coupled with the Pressure Vessel Research Committee (PVRC) recommendation for damping, to compute the dynamic component of the seismic response of piping systems, was completed. Response estimates for five piping/structural systems were developed using fourteen variants of the

ISM response spectrum method, the Uniform Support Motions response spectrum method and the ISM time history analysis method, all based on the PVRC recommendations for damping. The ISM/PVRC calculational procedures were found to exhibit orderly characteristics with levels of conservatism comparable to those obtained with the ISM/uniform damping procedures. Using the ISM/PVRC response spectrum method with absolute combination between group contributions provided consistently conservative results while using the ISM/PVRC response spectrum method with square root sum of squares combination between group contributions provided estimates of response which were deemed to be acceptable.

39957 **(ORNL/TM—10654) Oak Ridge Research Reactor shutdown maintenance and surveillance: Quarterly report, July, August, and September 1987.** Coleman, G.H.; Laughlin, D.L. (Oak Ridge National Lab., TN (USA)). Apr 1988. Contract AC05-84OR21400. 14p. NTIS, PC A03/MF A01; GPO Dep. Order Number DE88007773/JAW.

The ORR was not operated during July, August, and September of 1987. Maintenance activities, both mechanical and instrument, were essentially routine in nature. Details of fuel usage and inventory are listed. An analysis of shutdowns, maintenance of instrumentation, controls, process systems and status of filters are also presented. 10 tabs.

39958 **(PNL-SA—14745) Emergency planning lessons learned from a review of past major radiological accidents.** Stephan, J.G.; Selby, J.M.; Martin, J.B.; Moeller, D.W.; Vallario, E.J. (Pacific Northwest Lab., Richland, WA (USA); Harvard Medical School, Boston, MA (USA); USDOE Assistant Secretary for Nuclear Energy, Washington, DC. Office of Nuclear Safety). Nov 1987. Contract AC06-76RL01830. 5p. (CONF-880404—13). NTIS, PC A02/MF A01. Order Number DE88008199/JAW.

From 7. international congress of the International Radiation Protection Association; Sydney, Australia (10 Apr 1988).

In examining a range of nuclear accidents from the 1950s to the present that were reported in the literature, the authors have identified a number of contributing factors which affected human judgement during these events. One common thread found in a large number of accidents is the time of occurrence; a second is the fallibility of emergency training. This paper reviews these and other major cause of accidents and suggests emergency procedures improvements. 7 refs.

39959 **(SAND—87-2455C) The coarse mixing of boiling and isothermal jets.** Marshall, B.W. Jr.; Beck, D.F. (Sandia National Labs., Albuquerque, NM (USA)). Jan 1988. Contract AC04-76DP00789. 20p. (CONF-880724—9). NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88005531/JAW.

From 25. American Society of Mechanical Engineers/American Institute of Chemical Engineers/American Nuclear Society national heat transfer conference; Houston, TX, USA (24 Jul 1988).

Recent observations inside the Three Mile Island-Unit 2 reactor core have shown that about 20 tons of previously molten core material have relocated into the lower plenum. The core material is believed to have poured through holes in the flow-distributor and core-support plates, creating jets of molten corium falling through water. The experimental work described in this paper investigates the transient coarse-mixing of both molten and isothermal jets of material flowing into relatively deep ({approximately}1.5 m) water chambers. Results from the boiling-jet experiments show that significant fragmentation of the jet occurs as the jet enters and flows into the water. The isothermal jet-mixing experiments show the hydrodynamic fragmentation of the jet caused by instabilities, growth of surface disturbances, and by capillary and inertial forces. Comparison of the results from the two types of experiments show that the breakup of a boiling-jet depends upon the vapor generation rates and magnitudes as well as the flow of that vapor out of the mixture region. Thus, when reactor safety analyses are performed, liquid-gas or isothermal liquid-liquid jet-mixing data should not be directly extrapolated to predict the mixing behavior in the lower plenum.

39960 **(SAND—88-0861C) Interactions of core debris with concrete: The current state of the art, research, and remaining issues.** Powers, D.A. (Sandia National Labs., Albuquerque, NM (USA)). [1988]. Contract AC04-76DP00789. 20p. (CONF-880309—5). NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88010832/JAW.

From International symposium on severe accidents in nuclear power plants; Sorrento, Italy (21 Mar 1988).

Substantial progress has been made in the understanding of core debris interactions with concrete. Sophisticated models of these interactions have been developed based largely on tests of simple steels interacting with concrete. The paper describes additional tests and modeling in the areas of heat transfer, radionuclide release and combined core debris/concrete/coolant interactions needed to complete the understanding of core debris interactions with concrete for accident analysis. Major needs exist for tests involving oxide melts, metallic melts containing zirconium and metallic melts containing boron carbide. Radial heat transfer and the effects of water on core debris/concrete interactions are largely unstudied. Tests and modeling are needed to clarify issues of radionuclide release such as the effects of boron carbide, interfacial crusts, melt constituent activities, oxide phase oxygen potentials and vapor phase speciation.

39961 **(SAND—88-1335C) Hydrogen generation during fuel-coolant interactions: Results from the fits-D series.** Marshall, B.W. Jr. (Sandia National Labs., Albuquerque, NM (USA)). 1988. Contract AC04-76DP00789. 15p. (CONF-8806143—2). NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88011815/JAW.

From 2. nuclear reactor severe accident chemistry symposium; Toronto, Canada (5 Jun 1988).

The US Nuclear Regulatory Commission has been sponsoring research at Sandia National Laboratories to investigate the interaction of molten core materials with water. These interactions play an important role during severe core-melt accidents inside a pressurized light water reactor. They influence the rates and magnitudes of hydrogen and steam generated, the characteristics of the debris bed created in the lower plenum after melt-relocation, the transient pressurization of the primary system, and the fission product release characteristics and timing. Furthermore, since the core is cooled with water, an understanding of the parameters that control the behavior of these fuel-coolant interactions (FCIs) is necessary to make correct accident-management decisions. In an effort to assist in the understanding of these and other FCI-related issues, as well as provide important data for model development and validation, six FCI experiments were conducted at Sandia. Results discussed include the transient gas-phase pressures, the magnitude of hydrogen generation and the posttest debris characteristics.

39962 **(SSI—87-13) Radiation doses in Sweden as a result of the Chernobyl fallout.** (National Inst. of Radiation Protection, Stockholm (Sweden)). Apr 1987. 15p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88752723/JAW.

The dose to people living in Sweden originates mainly from external radiation from the ground and from internal radiation from radioactive materials accumulated in the body via foodstuff. In addition there are an inhalation dose and a dose from the radioactive cloud. The collective dose in nSv for the 1st year and for 50 years is evaluated.

39963 (TPR-NS—29-No.1, pp 94-99) **Reports, standards, and safety guides.** Queener, D.S. 1988. I. Order Number TI88000602/JAW.

In Nuclear Safety: Technical progress review, January-March 1988.

This article contains four lists of various documents relevant to nuclear safety as compiled by the editor. These lists are: (1) reactor operations-related reports of US origin, (2) other books and reports, (3) regulatory guides, and (4) nuclear standards. Each list contains the documents in its category which were published (or became available) during the three-month period (July, August, and September 1987) covered by this issue of Nuclear Safety. The availability and cost of the documents are noted in most instances. 99 references.

39964 (YJT—87-12) Safety analysis of disposal of decommissioning wastes from Loviisa nuclear power plant. Vieno, T.; Nordman, H.; Rasilainen, K.; Suolanen, V. (Voimayhtioeiden Ydinjaetetoimikunta, Helsinki (Finland)). Dec 1987. 158p. (In Finnish). NTIS (US Sales Only), PC A08/MF A01. Order Number DE88754094/JAW.

The repository for decommissioning wastes from the Loviisa nuclear power plant consisting of two 445 MWe PWR units is planned to be excavated at the depth of 90-130 meters in the bedrock of the power plant site. The reactor vessels weighing each about 215 tons will be transferred each in one piece into the repository. They are emplaced in an upright position in big holes excavated in the bottom of repository caverns. The reactor vessel internals are then emplaced inside the vessels. Finally, the vessels will be filled with concrete and the lids will be emplaced and sealed. Steam generators and pressurizers will also be disposed of uncutted. Other decommissioning wastes will be cut into smaller pieces and emplaced in concrete or wooden containers. The repository will be situated on the small island on which the power plant is located. The groundwater on the island contains two zones of different salinity: an upper zone of fresh, flowing groundwater and a lower zone of saline, stagnant groundwater where the repository will be situated. Three groundwater scenarios have been considered in the safety analysis: a scenario based on the present site conditions, an altered scenario where the repository is assumed to be situated in a zone of fresh, flowing groundwater and a distruptive event scenario with an intensive groundwater flow through the repository. The obtained results of the analysis show clear safety margins. In the basic scenario the maximum annul dose rate is $6x10^{-14}$ Sv/a via the local sea pathways, $6x10^{-11}$ Sv/a via the lake pathways and $4x10^{-8}$ Sv/a via a well bored in the vicinity of the repository. In the altered groundwater scenario the maximum annual dose rate is $4x10^{-10}$ Sv/a via the sea pathways, $3x10^{-7}$ Sv/a via the lake pathways and $1x10^{-5}$ Sv/a via the well pathway. In the unlikely disruptive event scenario the corresponding dose rates are $8x10^{-10}$ Sv/a (sea), $7x10^{-7}$ Sv/a (lake) and $2x10^{-4}$ Sv/a (well).

39965 (YJT—87-15) Decommissioning of the Olkiluoto nuclear power plant. Nykyri, M.; Peltonen, E.; Poellaenen, L.; Salonen, P. (Voimayhtioeiden Ydinjaetetoimikunta, Helsinki (Finland)). Dec 1987. 51p. (In Finnish). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88754095/JAW.

A conceptual plan is presented for the decommissioning of the Olkiluoto nuclear power plant. Deferred dismantlement after a storage period of 30 years is the main alternative. No detailed work plan for the demolition of structures is included. However, the world-wide development of demolition techniques for nuclear facilities has proven that the task can be performed using the existing technology. The decommissioning waste will be packed into concrete containers and wooden boxes. The total package volume is estimated at 8,000 and 30,000 m^3 depending on the treatment method. The higher figure stands for packing without any volume reduction. The activated reactor core components (fuel channels, control rods, neutron flux detectors) from the operational time of the Olkiluoto power plant are included in the decommissioning plan. The total activity of the contaminated and activated structures to be dismantled will be about $1x10^{16}$ Bq after 30 years from the shut-down. The corresponding figure for the activated core components will be about $2x10^{16}$ Bq. The radiation doses to personnel can be kept very low if the surface contamination of the large systems remains at a low level as it has done so far. The decommissioning waste is planned to be disposed of at the Olkiluoto site next to the reactor waste repository in the granitic bedrock at a depth of 50-100 m. The decommissioning waste repository will consist of two silos for the low-level waste and a hall for the activated metal waste. The barriers in the case of the metal waste hall will consist of the waste packages themselves, of 0.75 and 1 m thick concrete walls, of the 1 m thick bentonite/crushed rock backfill, and of the bedrock. The dismantlement will be finished by the year 2050, and the repository can be closed and sealed by 2055. The estimated decommissioning cost is FIM 808 million including the long-term storage and disposal.

39966 Waste management for the Shippingport Station Decommissioning Project. Mullee, G.R.; Schulmeister, A.R. (Nuclear Energy Business Operations, General Electric Co., Shippingport, PA 15077 (US)). pp 453-455 of Waste management '87: Waste isolation in the US, technical programs and public education. Post, R.G. Tucson, AZ; University of Arizona Nuclear Engineering Dept. (1987). (CONF-870306—).

From Waste management '87; Tucson, AZ, USA (1 Mar 1987).

The Shippingport Station Decommissioning Project (SSDP) is being performed by the US Department of Energy (DOE) with the objectives of placing the station in a radiologically safe condition, demonstrating safe and cost effective dismantlement and providing useful data for future decommissioning projects. This paper describes the development of the Waste Management Plan which is being used for the accomplishment of the SSDP. Significant aspects of the Plan are described, such as the use of a process control and inventory system. The current status of waste management activities is reported. It is concluded that SSDP has some unique aspects which will provide useful information for future decommissioning projects.

39967 Efficient variational solution of the transient radial-azimuthal heat transport in nuclear fuel rod arrays. Saltos, N.T. Columbus, OH; Ohio State Univ. (1987). 300p. University Microfilms Order No. 87-17,716.

Thesis (Ph. D.).

An efficient variational method was developed for transient radial-azimuthal heat conduction in nuclear rod bundles under Loss-of-Coolant Accident conditions. The method is fast running, gives the solution in a readily usable form, is easy to program, uses the same algorithm for one-dimensional and two-dimensional calculations, and is compatible with modular computer codes used in the nuclear industry. The trial functions for the temperature fields in fuel and cladding regions are parabolic in the radial direction. A Fourier series in place of the constant term of the parabola takes into account azimuthal variations at the inner or outer radius. Finally, a second Fourier series in place of the coefficient of the variable term of the parabola takes into account variation s in maximum radial temperature differences in the azimuthal direction. A comparison was made with the explicit finite-difference method. The criteria were: (1) maximum clad and fuel temperature histories; (2) maximum azimuthal temperature differences; and (3) shape of azimuthal temperature profiles. It was found that, on the average, the variational method is three times faster and at least as accurate. Effective heat transfer coefficient and gap conductance azimuthal profiles were linked to trial functions to limit computer calculations to the minimum necessary for required accuracy. Azimuthal temperature variations in a rod bundle were studied using the variational method.

39968 Nuclear power plant maintainability (human factors studies). Badalamente, R.V. (Battelle Pacific Northwest Labs., Richland, WA (USA)). *Personnel Selection and Training Bulletin;* 5: No. 4, 227-232(Dec 1984). Contract AC06-76RL01830.

The March 28, 1979 accident at Three Mile Island Nuclear Power Plant focused national attention on the safety of U.S. nuclear power plants. The Nuclear Regulatory Commission (NRC) took immediate action to redress the deficiencies highlighted as a result of the numerous investigations following TMI, and began a longer-term reassessment of overall safety aspects of nuclear power plant design and operation. A common theme, and key feature of TMI Action Plan, was the need to improve the manner in which human factors were dealt with in power plant design and operation. The purpose of this article is to summarize the results of a recent study of human factors in nuclear power plant (NPP) maintenance conducted by the Battelle Pacific Northwest Laboratories for the NRC (Badalamente, et al., 1982). The primary focus of the study was on maintainability, although other areas of maintenance are touched upon.

39969 **Inherently safe technologies-chemical and nuclear.** Weinberg, A.M. (Oak Ridge Associated Universities, TN (USA)). *Institute for Energy Analysis Newsletter;* 6: No. 4, 1, 3(Fal 1984). Contract AC05-76OR00033.

Probabilistic risk assessments show an inverse relationship between the likelihood and the consequences of nuclear and chemical plant accidents, but the Bhopal accident has change public complacency about the safety of chemical plants to such an extent that public confidence is now at the same low level as with nuclear plants. The nuclear industry's response was to strengthen its institutions and improve its technologies, but the public may not be convinced. One solution is to develop reactors which do not depend upon the active intervention of humans of electromechanical devices to deal with emergencies, but which have physical properties that limit the possible temperature and power of a reactor. The Process Inherent Ultimately Safe and the modular High-Temperature Gas-Cooled reactors are two possibilities. the chemical industry needs to develop its own inherently safe design precepts that incorporate smallness, safe processes, and hardening against sabotage. 5 references.

25 ENERGY STORAGE

2501 Magnetic

REFER ALSO TO CITATION(S) 40636

2504 Capacitor Banks

REFER ALSO TO CITATION(S) 39613, 40454, 40457

2505 Flywheels

39970 (ESA-SP—279, pp vp) **Advanced low-cost 2-axis active magnetic bearing flywheel.** Gauthier, M.; Roland, J.P.; Vaillant, H.; Robinson, A.A. (European Space Research and Technology Center, ESTEC, Noordwijk (Netherlands)). Dec 1987. NTIS, PC A14/MF A01. (ETN—88-91973; CONF-8709305—).

From 3. European space mechanisms and tribology symposium; Madrid, Spain (30 Sep 1987).

A magnetic bearing reaction wheel is described. It features a compact and very stiff magnetic bearing of the two axis active type, a brushless dc drive motor with very low ripple torque, fully redundant built-in electronics for the suspension and drive functions, and a simple locking mechanism for securing the inertial rotor member during launch. The construction features of the unit are discussed and its overall characteristics and performances are given. The latter compare favorably with those of ball bearing wheels with the same momentum capacity.

39971 (ESA-SP—279, pp vp) **Qualification of the OLYMPUS reaction wheel.** Sturtivant, G.J. Dec 1987. NTIS, PC A14/MF A01. (ETN—88-91973; CONF-8709305—).

From 3. European space mechanisms and tribology symposium; Madrid, Spain (30 Sep 1987).

Functional (torque) vibration, thermal vacuum, and life tests on the OLYMPUS satellite 10 Nms reaction wheel are summarized. Test equipment and procedures are described. Results are satisfactory.

39972 (ESA-SP—279, pp vp) **Evolution of large momentum and reaction wheels.** Heimel, H. Dec 1987. NTIS, PC A14/MF A01. (ETN—88-91973; CONF-8709305—).

From 3. European space mechanisms and tribology symposium; Madrid, Spain (30 Sep 1987).

Momentum and reaction wheels with diameters of 45 and 60 cm producing angular momentum ceilings of 300 and 1000 Nms are presented. For the 1000 Nms wheel, an engineering model is being built and tested. Design and expected performance data are given. A modular family of flywheels with momentums between 1 and 1000 Nms is also presented.

2506 Thermal

REFER ALSO TO CITATION(S) 39553

39973 **(PB—88-190814/XAB) Storage of thermal energy by means of an absorption cycle.** Ruiter, J.P. (Keuring van Electrotechnische Materialen N.V., Arnhem (Netherlands)). 1987. 114p. NTIS, PC E05/MF A01.

See also PB—88-150834. Pub. in Kema Scientific and Technical Reports, Vol. 5, No. 7, 101-210(1987).

The possibilities for storing thermal energy by means of an absorption cycle are described. In such a cycle two components of a mixture are separated by the supply of energy (heat or mechanical energy). The components can be stored at ambient temperature; consequently, there is no heat loss during storage. At the moment of heat demand, both components are recombined to produce heat of absorption. This heat consists of the heat of mixing and the heat of condensation, provided that one of the components is gaseous. The required heat of evaporation is extracted from the environment. The energetic efficiency of such a cycle, related to the net heat production and the supplied primary energy, can theoretically be over 100%. The absorption cycle was investigated for three different storage alternatives. In the first alternative the components are separated by heat supply. The heat of condensation of the gaseous component is transferred to the environment. The energetic efficiency of this cycle is less than 100%. In the second storage alternative, the heat of desorption is supplied by a heat pump that uses the heat of condensation as a heat source. In the third alternative the heat of condensation is produced at such a high temperature that this heat can be used directly for desorption. To achieve this higher temperature, the gaseous component is condensed at a higher pressure. A compressor is applied for this purpose.

39974 **(PW—1983) Geotechnical aspects for thermal storage in aquifers.** Morofsky, E.L.; Mirza, C. (Public Works Canada, Ottawa, Ontario; Mirza (C.) Engineering, Inc., Don Mills, Ontario (Canada)). [1983]. 9p. (CE—01668). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

The large scale seasonal storage of thermal energy in naturally occurring underground aquifers has been given the acronym ATES (Aquifer Thermal Energy Storage). In view of the growing interest in ATES technology throughout the world, it would be wise to set up, as early as possible, a communications framework to sort, store and retrieve an ever growing body of information on field experiences. Standardization of terminolgy and relevant factors to be measured and reported is clearly necessary to facilitate technology transfer in a meaningful way. Hence, the relevant geotechnical factors must be noted for any attempts at rationalization of predictive models. This paper presents a description of the various geotechnical factors which influence ATES technology. Comments are included on the management and cost aspects of two Canadian demonstration studies which have benefited from an awareness of the geotechnical factors relevant to ATES projects. Experience with these projects indicates the need for standardization of terminology, symbols and units in ATES applications. Recommendations have been given in this paper for a proposed classification and grouping of the commonly used terms to enhance technical communications among workers in this field. 8 refs., 1 figs., 2 tabs.

2509 Batteries

REFER ALSO TO CITATION(S) 40317, 40471, 40478

39975 **(AD-A—190257/6/XAB) Propulsion alternatives for an undersea autonomous vehicle. Master's thesis.** Braun, J.L. (Massachusetts Inst. of Tech., Cambridge (USA). Dept. of Ocean Engineering). Jun 1987. 87p. NTIS, PC A05/MF A01.

A study was conducted to determine suitable energy systems for small undersea autonomous vehicles. The two main goals of this study were: (1) to evaluate energy systems able to provide 16 kW-hr for a vehicle of specified dimensions, and; (2) to evaluate energy

systems that may be used in the future for longer-duration, higher-speed missions. It was concluded that silver-zinc secondary batteries are satisfactory for the low-energy requirement. There is some uncertainty about the most-suitable energy source for the higher-energy mission. There are no fully developed systems completely safe, reliable, and readily available for use. Lithium thionyl chloride batteries, and lithium sulfur hexafluoride thermal power plants are the main contenders and have comparable energy densities. There are concerns, however, about the safety and availability of each of these systems.

39076 **(AD-A—191394/6/XAB) Effects of cadmium-electrode properties on nickel-cadmium cell performance. Technical report.** Zimmerman, A.H. (Aerospace Corp., El Segundo, CA (USA). Chemistry and Physics Lab.). 30 Dec 1987. 24p. (TR—0086(6945-01)-2). NTIS, PC A03/MF A01.

Tests were conducted on several nickel-cadmium cells that have exhibited a variety of performance problems, ranging from high voltages and pressures during overcharge to low capacity. The performance problems that have been specifically linked to the cadmium electrode are primarily related to two areas, poor sinter and the buildup of excessive pressure during overcharge. A number of specific nickel-cadmium cell and cadmium-electrode characteristics were studied in this work to determine the effects of poor sinter overcharge in cells that otherwise appear normal. Several of the tests appear suitable for screening and electrodes for such problems.

39077 **(AD-A—191411/8/XAB) Nickel hydroxide active-material densities. Technical report.** Zimmerman, A.H.; Effa, P.K. (Aerospace Corp., El Segundo, CA (USA). Chemistry and Physics Lab.). 5 Feb 1988. 44p. (TR—0086A(2945-01)-3). NTIS, PC A03/MF A01.

The density of nickel-electrode active materials was measured in situ as a function of the state of charge and operating conditions of the nickel electrode. Sintered electrodes made by both chemical and electrochemical impregnation methods were studied, and the effects of cobalt additives on the density and compressibility of the active material were determined. The results clearly indicate a phase transition that occurs when the active material is charged above an oxidation state of about 2.7. The transition involves large changes in the density, volume, and compressibility of the active material. Changes in density during open-circuit stand, cycling, and trickle charging were measured and the results correlated with the operating characteristics of nickel electrodes in battery cells.

39078 **(AD-A—191946/3/XAB) Nickel-hydrogen low-earth-orbit life testing. Technical report.** Badcock, C.C.; Haag, R.L. (Aerospace Corp., El Segundo, CA (USA). Chemistry and Physics Lab.). 1 Feb 1988. 20p. (TR—0086(6909-05)-1). NTIS, PC A03/MF A01.

A program to demonstrate the long-term reliability of nickel-hydrogen (NiH_2) cells in low-earth orbit (LEO) and support use in mid-altitude orbit (MAO) was initiated. Both 3.5- and 4.5-in.-diameter NiH_2 cells are included in the test plan. Cells from all U.S. vendors are to be tested. The tests will be performed at -5 and 10 C at 40 and 60% depth of discharge (DOD) for LEO orbit and 10 C and 80% DOD for MAO orbit simulations. The goals of the testing are 20,000 cycles at 60% DOD and 30,000 cycles at 40% DOD. Cells are presently undergoing acceptance and characterization testing at Naval Weapons Support Center (NWSC), Crane, Indiana. Funding was provided by the Air Force Space Technology Center (AFSTC) and two AF System Program Offices (SPO's) to initiate the testing, but additional funding must be acquired to complete the purchase of cells and to assure completion of the testing.

39079 **(ANL—8011906) ANL Electrochemical Program for DOE/EHP: Quarterly technical progress report for July through September 1987.** (USDOE Assistant Secretary for Conservation and Renewable Energy, Washington, DC. Electric and Hybrid Propulsion Div.; Argonne National Lab., IL (USA)). Feb 1987. Contract W-31109-ENG-38. 17p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88011906/JAW.

This quarterly technical progress report summarizes the status and the key results for the ANL Electrochemical Program for the period of July 1, 1987 through September 30, 1987. The Argonne National Laboratory (ANL) Electrochemical Program for DOE/EHP carries out research, development, and evaluation directed toward improved electrochemical systems for future application in electric and hybrid vehicles. The program is one of the activities of the DOE Division of Electric and Hybrid Propulsion (DOE/EHP) and is conducted by the Electrochemical Technology Center at ANL.

39080 **(EPRI-AP—5845) Design and costs for a generic 10-MW utility lead-acid battery energy storage plant: Final report.** Eckroad, S.W.; Dodds, D.D. Jr.; Stolte, W.J. (Electric Power Research Inst., Palo Alto, CA (USA); Bechtel Group, Inc., San Francisco, CA (USA)). Jun 1988. 239p. Unlimited audience, publicly available. Research Reports Center, Box 50490, Palo Atlo, CA 94303;3. Order Number TI88012236/JAW.

The lead-acid battery is a flexible storage technology option that is commercially available today. Battery energy storage offers unique benefits not available from other storage and/or generation options. A conceptual-level design of a generic 10 MW, 50 MWh battery energy storage facility was performed. The design addresses equipment selection, environmental and safety issues, and plant availability. Plant performance characteristics are documented for the baseline plant and smaller capacity 10 MW, 30 and 40 MWh plants. An engineering cost estimate was prepared for the baseline plant and several design alternatives. Costs were estimated for mature as well as first-of-a-kind plants. Estimates were also developed for owner's costs, operation and maintenance costs, and battery replacement costs. An engineering and construction schedule was prepared. Supporting material in the report includes a technical specification for a 10 MW power conditioning system. 26 figs., 25 tabs.

39081 **(NP—8770291) Inductive battery heating. Studies on the heat transmission performance in lead starter batteries.** Voelkel, G. (Universitaet der Bundeswehr, Hamburg (Germany, F.R.). Fachbereich Elektrotechnik). 20 Jan 1984. 176p. (In German). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88770291/JAW.

Lead starter batteries are used predominantly for starting the engine, running the lights, ignition and supplying electrical equipment when the engine is not running. Because their operating efficiency depends on temperature, battery-heaters have been developed to ensure reliable starting for vehicles subject to particular requirements concerning their use at low ambient temperatures. The inductive type of battery heating, in which an alternating magnetic field transfers the heat output to the battery, has acquired special practical significance among those that have become known. This study examines the way in which the inductive heat transfer to the starter battery works. It is now possible to use a newly-developed method to determine separately the iron losses which occur during heat transfer to the components of the inductive heating system and demonstrate their dependency on operational parameters. Using different breakdowns of output, a complete picture of the interaction and significance of the system components involved in the heat transfer is given.

39082 **(PB—88-195326/XAB) Report of the Government Industrial Research Institute, Osaka, No. 372, October 1987. Study on the secondary battery using perchlorate-graphite intercalation compound.** Takada, Y. (Government Industrial Research Inst., Osaka, Ikeda (Japan)). 1987. 110p. NTIS, PC E05/MF A01.

See also PB—87-188256.

The purpose of the study is the preparation of perchlorate-graphite intercalation compound and its application to a secondary battery. As an application of the study, a secondary battery of lithium-graphite intercalation compound was constructed and its characteristics were examined.

39983 (PB—88-864921/XAB) Battery electrodes: properties and performance. July 1983-May 1987 (Citations from the Engineering Index data base). Report for July 1983-May 1987. (National Technical Information Service, Springfield, VA (USA)). May 1988. 166p. NTIS PC N01/MF N01.

This bibliography contains citations concerning battery electrodes relative to research and development in electrode technology, chemical solutions, materials improvement, reactions, rechargeability, and reliability. Electrochemical and thermodynamic characteristics, materials testing and evaluation, and corrosion protection are included. (This updated bibliography contains 367 citations, none of which are new entries to the previous edition.)

39984 (PB—88-864939/XAB) Battery electrodes: properties and performance. June 1987-May 1988 (Citations from the Engineering Index data base). Report for June 1987-May 1988. (National Technical Information Service, Springfield, VA (USA)). May 1988. 112p. NTIS PC N01/MF N01.

Supersedes PB—87-860193.

This bibliography contains citations concerning battery electrodes relative to research and development in electrode technology, chemical solutions, materials improvement, reactions, rechargeability, and reliability. Electrochemical and thermodynamic characteristics, materials testing and evaluation, and corrosion protection are included. (This updated bibliography contains 240 citations, all of which are new entries to the previous edition.)

39985 (PNL—6475) Metal-air battery assessment. Sen, R.K.; Van Voorhees, S.L.; Ferrel, T. (Pacific Northwest Lab., Richland, WA (USA)). May 1988. Contract AC06-76RL01830. 84p. NTIS, PC A05/MF A01;1; GPO Dep. Order Number DE88011361/JAW.

The objective of this report is to evaluate the present technical status of the zinc-air, aluminum/air and iron/air batteries and assess their potential for use in an electric vehicle. In addition, this report will outline proposed research and development priorities for the successful development of metal-air batteries for electric vehicle application. 39 refs., 25 figs., 11 tabs.

39986 (RFW—TP3110) Battery research and development in Canada. (Webb (R.F.) Corp. Ltd., Ottawa, Ontario (Canada)). Jun 1981. 138p. (In English and French). (CE—01730). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

The report analyzes the current state of battery research and development (R & D) in Canada, with particular reference to rechargeable batteries for use in automobiles, electric vehicles and stationary electric power storage. The present and possible future levels of production of electricity in Canada are shown to be adequate to meet the energy need defined by the National Energy Program for the substitution of oil by alternatives. The production capacity in Canada and the large contribution to be made by hydroelectric power is such that there is no urgent need for the development of electric storage batteries for load-levelling by utilities, which is important elsewhere. The principal opportunity for Canada is shown to lie in the preservation of current and expanding markets for electric storage batteries for transport vehicles; both the existing type of starting, lighting and ignition battery and high performance batteries for electric vehicles. The analysis shows that R & D on batteries in Canada is both insufficient and unbalanced. Recommendations are made to rectify this situation, including expansion of battery R & D in Canada from the present level of about $2.5 million to the $10 million level within 5 years. Cost-to-benefit considerations are provided to show that this level of R & D is justified and overdue. 52 refs., 17 tabs.

39987 (SAND—87-2129C) Reliability analysis of lithium cells. Levy, S.C.; Bro, P. (Sandia National Labs., Albuquerque, NM (USA); Southwest Electrochemical Co., Santa Fe, NM (USA)). 1988. Contract AC04-76DP00789. 16p. (CONF-880598—2). NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88009258/JAW.

From 4. international meeting on lithium batteries; Vancouver, Canada (23 May 1988).

Fault tree analysis has been used for many years in safety and reliability analyses of nuclear reactors and other large systems. This technique can also be useful in the design of high reliability lithium cells/batteries and in improving the reliability of existing designs. The basic building blocks of a fault tree are discussed and an example, using the Li/SO_2 cell, is given.

39988 (SAND—87-2396C) Compatibility and performance of separators in Li/SOCl/sub 2] cells. Cieslak, W.R. (Sandia National Labs., Albuquerque, NM (USA)). 1988. Contract AC04-76DP00789. 7p. (CONF-880665—1). NTIS, PC A02/MF A01; GPO Dep. Order Number TI88011090/JAW.

From 33. international power source symposium; Cherry Hill, NJ, USA (13 Jun 1988).

Degradation of many common separator materials, such as polyethylene, excludes their uses in $SOCl_2$ electrolytes. Degradation of the binder in an otherwise chemically-resistant separator may also eliminate it for use in this aggressive environment. We are interested in a separator that does not degrade during >10-year storage in either active or reserve cells. Even in reserve configurations, degradation may occur by reaction with Li, Additionally, the separator must be flexible and strong enough for a spiral-wound cell, and it must have the proper thickness and porosity for optimum performance. The properties of three categories of separator materials have been investigated: polymers, glasses and ceramics. We have performed compatibility tests in $LiAlCl_4/SOCl_2$ electrolyte and in contact with Li (no electrolyte), and we have assessed electrochemical performance in laboratory cells. The purpose of these tests was to screen a wide variety of materials to identify several candidate separators so that a specific product might readily be chosen on the basis of application requirements. 4 refs., 4 figs., 1 tab.

39989 (SAND—87-3031C) Igniter and actuator output testing. Evans, N.A. (Sandia National Labs., Albuquerque, NM (USA)). 1988. Contract AC04-76DP00789. 20p. (CONF-880750—1; CONF-880750—). NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88008807/JAW.

From 13. international pyrotechnics seminar; Grand Junction, CO, USA (11 Jul 1988).

Closed system mechanical work output measurements were made for five types of thermal battery igniters and one type of valve actuator. Each unit was fired into a high-precision fit piston/cylinder arrangement, and the work output was determined from measuring the rise of a known weight. The results showed that work output for an individual igniter type varied over a considerable range while the mean work output values of the various igniter types appeared to depend principally on the type of closure disc and the details of the charge mix. The large variability in igniter output was the principal inducement to build a second apparatus, with approximately 10 times the capacity of the first, to investigate the output actuators. Compared with igniters, the actuator work output was appropriately in scale, but the variability was considerably reduced (R=1.5), and was attributed to increase in scale. Motion picture photography at 8000 to 9000 frames per second was used to determine the motion of the rising weight and the associated output pressure, which exhibited three distinct phases. Initially, the average acceleration of the weight was of the order of 100 g during the first half-millisecond of weight rise and corresponded to average pressures of 15,000 to 37,000 psi, depending principally on the mass of the weight. This was followed by a significant weight rise at a constant pressure of approximately 150 to 450 psi. Finally, the weight decelerated to rest under gravity to reach the maximum recorded height. 2 refs., 9 figs., 2 tabs.

39990 Battery lifetime prediction by pattern recognition. Application to lead-acid battery life-cycling test data. Perone, S.P.; Spindler, W.C. (Chemistry and Materials Science Dept., Lawrence Livermore National Lab., Livermore, CA (US)). pp 1 of Proceedings of the annual battery conference '86 on applications and advances. Long Beach, CA; California State University - Long Beach (1986). (CONF-860112—).

From Conference on applications and advances in battery technology; Long Beach, CA, USA (14 Jan 1986).

A novel approach to battery lifetime prediction has been evaluated by application to life-cycling data collected for 108 ESB

EV-106 6-V. golf cart batteries (tests conducted by TRW for NASA-Lewis). This approach utilized computerized pattern recognition methods to examine initial cycling measurements and classify each battery into one of two classes: "long-lived" or "short-lived." The classifier program was based on either a linear discriminant or nearest neighbor analysis of a training set consisting of: each member of the EV battery set which had failed; the relative lifetime of each member - normalized with respect to test conditions; and a set of "features" based on measurements of initial behavior. The raw data set included capacity trends over the first 8 or 9 cycles and records of specific gravity and water-added for each cell after initial cycling. Features defined from these raw data included the individual data items as well as transformations and combinations of these data. All features were represented as standardized variables. It was shown that lifetime prediction of batteries within the two categories defined could be made with about 87% accuracy. It is concluded that for a similarly-manufactured battery set, relative lifetime prediction could be based on initial measurements of the same type examined here.

39991 **Batteries in electric vehicle and solar conversion applications.** Clark, R. (Sandia Nat. Lab., Albuquerque, NM (US)). pp 265-344 of Proceedings of the annual battery conference '86 on applications and advances. Long Beach, CA; California State University - Long Beach (1986). (CONF-860112—).

From Conference on applications and advances in battery technology; Long Beach, CA, USA (14 Jan 1986).

The authors' discuss four electrochemical energy storage systems for which the Exploratory Battery Technology Development and Testing (ETD) Project has responsibility. They are the sodium/sulfer system, the zinc/bromine system, the hydrogen/nickel oxide system, and the sealed lead-acid system.

29 ENERGY PLANNING AND POLICY

REFER ALSO TO CITATION(S) 42544

39992 **(AD-A—190342/6/XAB) Department of Defense annual report on Chemical Warfare - Biological Defense Research Program obligations. Annual report, 1 October 1986-30 September 1987.** (Office of the Under Secretary of Defense for Research and Engineering, Washington, DC (USA)). 1 Dec 1987. 87p. (USDRE(A)—1065). NTIS, PC A05/MF A01.

Funding obligations for the Department of Defense Chemical Warfare - Biological Defense Research Program are presented and discussed.

39993 **(AD-A—190573/6/XAB) Structure for a knowledge-based system to estimate Soviet tactics in the air-land battle. Master's thesis.** Fletcher, A.M. (Air Force Inst. of Tech., Wright-Patterson AFB, OH (USA). School of Engineering). Mar 1988. 104p. (AFIT/GST/ENG—88M-2). NTIS, PC A06/MF A01.

The purpose of this thesis was to build a prototype decision aid that can use knowledge about Soviet military doctrine and tactics to infer when, where, and how the Soviet Army plans to attack NATO defenses given intelligence data about Soviet (Red) military units, terrain data, and the positions of the NATO (Blue) defenses. Issues are raised that must be resolved before such a decision aid, which is part of the Rapid Application of Air Power concept, can become operational. First examined is the need to shorten the C2 decision cycle in order for the ATOC staff to keep pace with the tempo of modern warfare. The Rapid Application of Air Power is a concept that includes automating various steps in the decision cycle to allow air power to be applied proactively to stop Soviet forces before they obtain critical objectives. A structure is presented for automating the second step in the decision cycle, assessing and clarifying the situation, through a knowledge-based decision aid for interpreting intelligence data from the perspective of Soviet (Red) doctrine and estimating future Red tactical objectives and maneuvers.

39994 **(AD-A—190719/5/XAB) Future of Europe and US national security. Study project.** McCloskey, C.C. (Army War Coll., Carlisle Barracks, PA (USA)). 17 Feb 1988. 31p. NTIS, PC A03/MF A01.

The world region that will most affect the national security of the United States in the next twenty-five years is Europe. Europe is the key region because of history and heritage, economics, geographic location, the military threat, technology growth, and increasing European unity. All these factors tie U.S. national interests to Europe, moreso than any other region. The vision of Europe twenty-five years hence is of an economically vibrant region, comfortable dealing with both East and West in trade and all other aspects of international relations, military less dependent on the United States, acting more as a unified region than separate countries and an emerging superpower in its own right. To safeguard its national security, the United States must respond to this future Europe in several ways. It must revise its European military strategy to include the phased withdrawal of all major ground forces, enhance American economic competitiveness while simultaneously stimulating East-West trade, adequately resource the national diplomatic effort and establish and sustain a consensus of support for this new strategy among the American people and their representatives.

39995 **(AE/MR—1987) Petroleum industry development in Canada. The relationship between governments and the private sector.** Day, M.J. (Alberta Energy, Edmonton (Canada). Mineral Resources Div.). 1987. 85p. (MICROLOG—88-01920). Alberta Dept. of Energy, Petroleum Plaza Twr., 9915-108 St., Edmonton, Alta., Canada T5K 2C9; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

This paper deals with the relationship between the public and private sectors in the Canadian petroleum industry, particularly with regard to exploration, development, and production. It was written from the perspective of the Alberta energy ministry and, since it was also written for the benefit of a seminar in China, includes comparisons with China for illustration. The report outlines the Canadian constitutional framework from the viewpoint of energy source ownership, and the distribution of producing and consuming areas in Canada from the viewpoint of their effect on energy policy. The differing priorities of public and private oil and gas development are examined along with the interaction of government and industry. Exploration, acquisition of rights, drilling and production, and their results (including marketing, reserves, and royalties) are discussed from the standpoint of how government policies affect them; illustration is made using Alberta examples. Finally, thirteen key requirements for effective government private sector relationships are presented. 56 figs.

39996 **(DOE/CE—0221) Ninth annual report to Congress and the Secretary of Energy on the Nationwide Energy Extension Service Program.** (National Energy Extension Service Advisory Board, Washington, DC (USA)). May 1988. 13p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88012405/JAW.

This is the Ninth Annual Report of the National Energy Extension Service Advisory Board to the Congress, the Secretary of Energy, and the Director of the Energy Extension Service program. The Board is charged by the National Energy Extension Service Act of 1977 [Public Law 95-39] with carrying on a continuing review of the Energy Extension Service program and, on at least an annual basis, reporting its status and any recommendations for improvement. The Board wishes to emphasize the following goals, each of which will be explained more fully in the body of the report: to recognize the role of energy conservation to our national security and the maintenance of our energy production infrastructure; to emphasize the role of the Energy Extension Service in energy emergency preparedness to provide support, assistance, and advice to appropriate state agencies; to increase energy education through improved cooperation and coordination; to have each state review the amount of Petroleum Violation Escrow funds being allocated for energy conservation education; to continue the transfer of information on proven programs, practices, and new technol-

ogies; and to continue the emphasis on evaluation of program effectiveness.

39997 **(PCPP/R—SP870014) Selective identification of olefins and paraffins in middle distillates of synthetic crude oil.** Notzl, H. (Petro-Canada Products, Sheridan Park, Ontario. Research and Development Centre). May 1987. 225p. (MICROLOG—88-02037). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1. $0.34 CAN per page, $3.40 minimum; MF $10 CAN.

The objective of this program was to assess methods needed to characterize the 160/sup 0/C-340/sup 0/C petroleum distillate fractions as used for diesel fuels. The methods were evaluated using materials originating from thermal processing of bitumen, thermal recovery of heavy oil and coal liquefication, in order to determine how the methods handled the different distillates. The bulk of this report consists of the analytical data obtained in the laboratory. The characterization included chemical composition by a variety of techniques including low resolution mass spectrometry, gas chromatography, gas chromatographic mass spectrometry, infrared spectroscopy, nuclear magnetic resonance spectroscopy and physical characteristics. The work showed that both the hydrocarbon composition and physical properties varied significantly depending on the origin. The methods, in most cases, gave very consistent results. As boiling ranges varied, widely direct comparison of the other properties should be carried out with caution. For any future work, the materials should be distilled to a constant boiling range and engine tests performed to ascertain diesel engine performance. 5 refs.

2901 Energy Analysis And Modeling

REFER ALSO TO CITATION(S) 40005, 40036, 40048

39998 **(DOE/EIA—M029) PC-AEO forecasting model for the {ital Annual Energy Outlook, 1987}: Model documentation.** (USDOE Energy Information Administration, Washington, DC. Energy Analysis and Forecasting Div.). Jun 1988. 569p. NTIS, PC A24 - GPO. Order Number DE88012247/JAW.

The object of the PC-AEO modelling system is to make forecasts of national energy trends by fuel and sector for the {ital Annual Energy Outlook} published each year by the Energy Information Administration (EIA). The model was built with the aim of representing the most significant national characteristics of the current IFFS/GAMS modelling system but entirely within the operating capability of a large personal computer, typically a fast "386" type of machine. The chapters that follow describe each of the models in detail. The purpose of this summary is only to distinguish each of them and to lay the foundation for the discussion of integration of the model results in the last section. Individual models include The Residential and Commercial Models, The Industrial Model, The Transportation Model, The Petroleum Product Pricing Model, The Macroeconomic Model, The Electric Utility Models, The Oil and Gas Models, and The Coal Model. Each of the models described above will operate independently on a large IBM compatible personal computer. Each will take a set of input assumptions: either supply prices or consumption quantities and will produce a set of output consumption quantities or supply prices. In addition the models each require macroeconomic drivers. Integration is achieved by the conceptually simple process of exchanging the price and quantity estimates repeatedly between the models until they are mutually consistent.

39999 **(MU/HEC—G8407) Toward a coupling between MEDEE and MARKAL based on research of a partially regulated balance.** Berger, C.; Haurie, A.; Lafrance, G.; Marcotte, P.; Surprenant, J.P. (Montreal Univ., Quebec (Canada). Ecole des Hautes Etudes Commerciales). Mar 1984. 39p. (In French). (CE—01732). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

This paper studies the possibility of effecting a coupling between MEDEE-3-QUEBEC, a computer model for simulating energy demand, and MARKAL-Production, a supply model, in view of obtaining a partial regulated balance. A research methodology is presented for such a balance based on mathematical programming. It is shown that it was possible to use MEDEE as a demand model, that is, it reacted to relatively minor modifications of the sole price factors, and the MARKAL-QUEBEC program can be adapted to a situation where the final demand is exogenous, and does not depend then on the competition between end-use technologies. The coupling model, once complete, will furnish a tool for analyzing energy scenarios for Quebec. It will also permit the validation of certain price hypotheses and the study of the impact of rate policies on the Quebec energy system. 15 refs., 11 figs., 5 tabs.

2902 Economics And Sociology

REFER ALSO TO CITATION(S) 39166, 39351, 39379, 39380, 39382, 39473, 40019, 40027, 40029, 40030, 40045, 40046, 40052, 40053, 40057, 40058, 40061, 40068, 40069, 40074, 40075, 40076, 40078, 40164, 40172, 42453

40000 **(DOE/ER/40300—T2) Economic analysis of payoffs from basic research. Final report.** (Stanford Univ., CA (USA)). 16 Dec 1987. Contract FG03-86ER40300. 7p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88011812/JAW.

A report of progress on a research projected funded by the Department of Energy to do an economic analysis of basic scientific research activities is presented. Research project procedures are outlined, along with the applicability of cost-benefit methodologies to basic science research programs. Also discussed is an information-theoretic approach to the economics of basic research, feasibility studies, and opportunities for future research.

40001 **(EMR/OEC—RR15) Investment in energy efficiency.** (Department of Energy, Mines and Resources, Ottawa, Ontario (Canada). Office of Energy Conservation). Sep 1977. 30p. (CE—01665). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

This study is an analysis of what motivates Canadian private industry to invest in energy efficiency. It is based on information collected during personal interviews with industrial energy users, equipment suppliers, trade associations, consultants and related personnel. It is apparent from responses to this survey that achieving higher energy efficiency, commitment from the chief executives is required. In order to obtain this commitment, the need for such a program and its purpose must be well explained. The level of concern about energy is generally superficial due to conflicting reports on the true state of Canada's energy reserves. Poor Canadian economic performance has tended to mean that industry concentrates on profits instead of new plant and equipment. Profitability of a particular corporation has an enormous effect on investment; the greater the profitability, the greater the capital for investing and the more likely the corporation will invest in projects of slow return on investment. Average current investment strategies call for a return on capital of no longer than two years. Very capital-intensive industries find it costly to make major energy efficiency improvements because whole sections of plants have to be rebuilt. In the current business climate, a powerful incentive is needed to attract the required capital. The Anti-Inflation Board is seen as a major disincentive to all investment in improved energy efficiency.

40002 **(PB—88-188578/XAB) Preliminary evaluation of the Illinois Residential Affordable Payment Program (IRAPP).** Reddy, A.B.; Griffin, B.S.; Lieberman, B.; Baker, D. (Illinois Dept. of Energy and Natural Resources, Springfield (USA)). Mar 1988. 332p. (IL/ENR/RE/PA—88/05). NTIS, PC A15/MF A01.

The Illinois Residential Affordable Payment Program (IRAPP) was authorized by the Illinois Energy Assistance Act of 1985. IRAPP is an energy-assistance program for low-income households that have incomes of less than 125% of poverty level and receive utility services from a public utility. In return for percent of income payments, low-income households are guaranteed

continuous natural gas and/or electricity utility service. The program was placed in operation in December 1985. The study reported here is an evaluation of this program. Program-eligible households were compared to determine: (1) what household characteristics lead to program participation; (2) what effects the program has on consumption of natural gas and electricity, utility-service disconnections, and low-income households' utility costs; and (3) how much the program cost per participant household.

40003 **(PB—88-928500/XAB) Economic and Energy Indicators. Bi-weekly report.** (Central Intelligence Agency, Washington, DC (USA)). 1988. vp. NTIS Subscription.

Supersedes PB—87-928500; Paper copy available on subscription, North American price $90.00/year; all others write for quote. Single copies also available.

The Economic and Energy Indicator provides up-to-date information on changes since 1977 in economic and energy activities of major countries. It consists of tables only. They depict (a) economic indicators (industrial production, unemployment, consumer price inflation, and exchange rate trends) for the Big Seven developed countries (United States, Japan, West Germany, France, United Kingdom, Italy, and Canada); (b) foreign trade and foreign trade prices for the Big Seven; and (c) monthly average prices for selected agricultural products and industrial materials. The energy indicators include tables on petroleum consumption, production, and imports for the Big Seven. A table and chart depict the movement of OPEC average crude oil sales prices since 1973.

40004 **(QER—8701) International trade of Quebec on the level of exporting energy-related products and services, 1980-1985.** Gauthier, M.; Roy, L. (Quebec Ministere de l'Energie et des Resources, Quebec (Canada)). Jul 1987. 169p. (In French). (MICROLOG—88-01616). Quebec Ministere de l'energie et des ressources, Direction des Communications, 200, chemin Ste-Foy, 7e etage, Quebec, P.Q., Canada G1R 4X7; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

This document has the objective of providing an overview of Quebec's international trade in those manufactured products connected with energy for the 1980-1985 period. The products considered here are selected by the following criteria: those used to produce, transport, distribute, conserve, or control energy; and devices used to produce heat or cold. Data on international trade are taken from unpublished Statisics Canada microfiches, which give market value according to a standard classification. These data include products merely passing through Quebec, so interpretation of such data must take this into account. The bulk of this report consists of these data in tabular form.

40005 **(VTT-TUTK—519) Energy conservation alternatives for the Finnish national economy until the year 2030.** Tamminen, E. (Valtion Teknillinen Tutkimuskeskus, Espoo (Finland)). Jan 1988. 131p. (In Finnish). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88753775/JAW.

The objectives for the study are: (1) To develop and to apply long term scenario analysis methods to energy production and use in the Finnish national economy, (2) to present for the years 1985-2030 scenarios, which concentrate on the potential and on the impacts of impacts of energy conservation and (3) to identify further research problems, central from the point of view of the future development of the national energy economy. In the report, an overview over the energy production and consumption system in the national economy is presented first. Then factors which may lead to changes in the structure or in the operation of the system are analysed. Further, the possibilities of the system to adapt to the changing environment are studied. In the fifth chapter we present problems of the future development of the energy economy, to be analysed and answered through a scenario approach. Possible analysis methods are also considered. In the first five chapters attempts are made to draw an overall picture of the system under study. In the sixth chapter two alternative scenarios are defined for the development of the Finnish economy until the year 2030, and also two scenarios for energy conservation are defined. In both conservation scenarios the use of domestic energy sources is developed. By combining the alternatives, four main scenarios are defined, and for these scenarios we compute the use of different fuels and electricity, energy production and raw energy consumption. The main results are: total use of energy and its distribution among energy sources and the consumption and production of electricity by production class. Finally some problems for later study are stated.

40006 **Effects of revenue distribution and income distribution on the impact of local taxation.** Jones, D.W.; Morrow-Jones, C.R. (Oak Ridge National Lab., TN (USA)). *Environment and Planning C: Government and Policy;* 2: 135-148(1984).

A computable equilibrium model of city government tax policy is constructed and analyzed for the impacts of taxes on all land and on capital, with four patterns of distribution of the tax revenue. Workers' utilities are exogenous. Choices of tax base and of tax distribution policy affect the extent of tax-exporting and the efficiency of tax collection, as does the distribution of landownership. Local land taxation is more efficient than local capital taxation, regardless of landownership patterns. A non-Tiebout theory of local government is implicit in the model, and interaction of government structure and choice of policies merits further study. 25 references, 3 tables.

2903 Environment, Health, And Safety

REFER ALSO TO CITATION(S) 39098, 39170, 39171, 39207, 39242, 39285, 39327, 39331, 39332, 39333, 39335, 39343, 39346, 39347, 39350, 39352, 39382, 39411, 39414, 39417, 39418, 39432, 39614, 39616, 39782, 39866, 39969, 40022, 40061, 40062, 40066, 40067, 41169, 41170, 41171, 41173, 41174, 41175, 41178, 41237, 41244, 41274, 41275, 41276, 41277, 41278, 41279, 41280, 41281, 41282, 41283, 41311, 41335, 41353, 41378, 41379, 41380, 41381, 41382, 41383, 41384, 41386, 41387, 41388, 41389, 41390, 41391, 41392, 41393, 41427, 41486, 41607

40007 **(BNL—40730) Advanced technologies for reduced CO_2 emissions.** Steinberg, M.; Cheng, H.C. (Brookhaven National Lab., Upton, NY (USA)). Dec 1987. Contract AC02-76CH00016. 20p. (CONF-880247—1; CONF-880679—1; CONF-880679—). NTIS, PC A03/MF A01;1. Order Number DE88006301/JAW.

From Conference on prospects for mitigating climatic warming by carbon dioxide control; Boston, MA, USA (11 Feb 1988).

It appears well established that there has been an increase in concentration of carbon dioxide in the atmosphere over the past 125 years. This has been generally attributed to (1) the exponential growth in the use of fossil fuel resulting in the release of fossil carbon as CO_2 and (2) the deforestation or the leveling of forests around the earth which reduced the photosynthetic utilization of atmospheric CO_2. Studies have been conducted for the Carbon Dioxide Research Division (CDRD) of the US Department of Energy relating to possible mitigation technologies which would tend to reduce CO_2 emissions in the future. 6 refs., 4 figs., 3 tabs.

40008 **(CONF-8805103—3) Designing a HAZMAT [hazardous materials] incident management system for facilities with widely varying emergency organization structures.** Carter, R.J.; Easterly, C.E. (Oak Ridge National Lab., TN (USA)). 1988. Contract AC05-84OR21400. 18p. (CONF-8805103—3; CONF-8805103—). NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88011384/JAW.

From Hazardous material spills conference; Chicago, IL, USA (16 May 1988).

Oak Ridge National Laboratory is currently conducting a research program for the United States Air Force, the purpose of which is to assist them in their emergency planning for HAZMAT spills. This paper describes the first two tasks in the program. These tasks are oriented towards: determining the extent of the hazardous materials (HAZMAT) problem and establishing plans directed toward HAZMAT incident management.

40009 **(DOE/ER—0185/4) Research in progress, FY 1988: Summaries of projects sponsored by the Office of Health and Environmental Research.** (USDOE Office of Energy Research, Washington, DC. Office of Health and Environmental Research). Mar 1988. 262p. NTIS, PC A12/MF A01;1; GPO Dep. Order Number DE88001334/JAW.

This reports provides a compilation of summaries of the research projects supported by the Office of Health and Environmental Research (OHER) during Fiscal Year 1988. The OHER, a component of the Office of Energy Research, is the health and environmental research arm of the US Department of Energy. The mission of the Office reflects a commitment to developing the beneficial uses of advanced energy sciences for the alleviation of human suffering, while at the same time assuring that any potentially adverse health and environmental impacts of energy technologies are fully understood. The program is broad in scope and diverse in character with substantial commitments to both applied and basic research. The research projects have been organized to reflect the major themes and focus of the OHER program, as outlined in the Contents.

40010 **(DOE/SR/10749—T2) 250 years of historic occupation on Steel Creek, Savannah River Plant, Barnwell County, South Carolina.** Brooks, R.D. (South Carolina Univ., Columbia (USA). Inst. of Archaeology and Anthropology). 1988. Contract AC09-81SR10749. 306p. NTIS, PC A14/MF A01;1; GPO Dep. Order Number DE88007812/JAW.

This report discusses the investigation of seven historic archaeological sites on the uppper coastal plain of the South Atlantic Slope in South Carolina. These seven sites are located on the United States Department of Energy's Savannah River Plant in the Steel Creek watershed. This project has its beginnings in 1980, when the Department of Energy initiated the reactivation of the L Reactor. At that time, the plan called for an increased thermal water discharage. In 1980, the Savannah River Plant Archaeological Research Program (SRP-ARP) conducted an intensive archaeological survey of the Steel Creek terrace edge and bottomland. In early 1984, the Department of Energy made the decision to construct a dam and create a cooling lake (L-Lake) on Steel Creek. This required a new survey. The new project initially was to be an intensive survey of the entire proposed lake area. However, construction time constraints changed the general outline of the project into a two-phased survey of the area. The first phase of the project was a survey of the dam, borrow area, discharge structure, and diversion canal. Ten sites were identified, none of which were considered eligible for nomination to the National Register of Historic Places. The second phase of the project was the intensive survey of the lake and embankment. Twenty-six sites were located in that portion of the survey, 11 of which were considered eligible for nomination to the National Register of Historic Places.

40011 **(IIUG-rep—86-13) Environmental reporting by large-scale enterprises. A study of annual business reports in the energy industry and the chemical industry.** Uka, W. (Wissenschaftszentrum Berlin fuer Sozialforschung gGmbH (WZB) (Germany, F.R.). Internationales Inst. fuer Umwelt und Gesellschaft). 1986. 53p. (In German). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88754006/JAW.

This study analyzes environmental reporting by large-scale enterprises in two branches of industry, chemicals and energy, for the period 1980-85. The study concentrates on the annual business reports. It was found that environmental reporting has clearly increased since 1982, especially in the energy industry. Reporting on environmental protection expenditures is more widespread in the chemical industry. Emission reporting is concentrated on only a few pollutants and, due to its many different forms of presenation, comparison of the individual companies and among companies are difficult. The final chapter presents possible ways to improve environmental reporting, primarily being directed at an improvement in the comparability of environmental reporting of industry. (orig./HSCH).

40012 **(ORNL—6446/R1) ORNL Long-Range Environmental and Waste Management Plan: Detailed management plan.** Bates, L.D.; Berry, J.B.; Butterworth, G.E.; du Mont, S.P.; Easterday, C.A.; Geisler, A.H.; Hill, L.G.; Kendrick, C.M.; McNeese, L.E.; Myrick, T.E.; Pudelek, R.E.; Rohwer, P.S.; Scanlan, T.F.; Stratton, L.E.; Trabalka, J.R.; Youngblood, E.L. (Oak Ridge National Lab., TN (USA)). Apr 1988. Contract AC05-84OR21400. 448p. NTIS, PC A19/MF A01;1; GPO Dep. Order Number DE88010659/JAW.

The primary purpose of this report is to provide a thorough and systematic planning document to reflect the continuing process of site asessment, strategy development, and planning for the current and long-term control of environmental issues, waste management practices, and remedial action requirements. The document also provides an estimate of the resources required to implement the current plan. This document is not intended to be a budget document: it is, however, intended to provide guidance as to the near order of magnitude of the resources (primarily funding requirements) and the time frame required to execute the strategy in the present revision of the plan. As with any document of this nature, the near-term (one to three years) part of the plan is a realistic assessment of the current program and ongoing capital projects and reflects the efforts perceived to be necessary to comply with all current state and federal regulations and DOE orders. It also should be in general agreement with current budget (funding) requests and obligations for these immediate years. Beyond the immediate time frame, the document reflects the strategy and the project and funding estimates as a snapshot at the time of publication. This is intended to be a living document with annual revision to reflect the continuing evolution and development of environmental and waste management processes, characterizations, remedial actions, regulations, and strategies for the establishment and conduct of a comprehensive environmental and waste management program designed to be in compliance with state and federal regulations and guidelines designed to protect human health and the natural environment. 57 figs., 78 tabs.←

40013 **(PB—88-188560/XAB) Solid-waste-management alternatives: review of policy options to encourage waste reduction.** Zimmermann, E. (Illinois Dept. of Energy and Natural Resources, Springfield (USA). Div. of Energy and Environmental Affairs). Feb 1988. 91p. (IL/ENR/RE/PA—88/03). NTIS, PC A05/MF A01.

In order to adopt effective waste-reduction policies, States must first develop a framework for evaluating alternative policy options. Such a framework should include a clear definition of waste reduction, a set of policy evaluation criteria, consideration of a variety of policy approaches, and targeting of policies to appropriately distinguished sectors of waste generators. Three general approaches are possible to encourage waste reduction: (a) regulatory approaches; (b) financial incentives and/or disincentives; (c) research and education. This report outlines a wide range of policy options that encourage both post-consumer and industrial waste reduction. The most effective waste-reduction policies will most probably include a balanced mixture of educational programs, financial incentives/disincentives, and regulations designed to best meet overall waste-reduction goals consistent with established evaluation criteria.

40014 **(PB—88-189436/XAB) Process design manual: land treatment of municipal waste water.** (Environmental Protection Agency, Cincinnati, OH (USA). Center for Environmental Research Information). Oct 1981. 483p. (EPA—625/1-81/013). NTIS, PC A21/MF A01.

See also PB—88-189444.

This manual presents a rational procedure for the design of land-treatment systems. Slow-rate, rapid-infiltration, and overland-flow processes for the treatment of municipal waste waters are discussed in detail, and the design concepts and criteria are presented. A two-phased planning approach to site investigation and selection is also presented. The manual includes examples of each process design. Information on field investigations is presented along with special considerations for small-scale systems. Equations and procedures are included to allow calculations of energy requirements for

land-treatment systems. Potential health and environmental effects and corresponding mitigation measures are discussed.

40015 **(PB—88-189444/XAB) Process design manual: land treatment of municipal waste water. Supplement on rapid infiltration and overland flow.** (Environmental Protection Agency, Cincinnati, OH (USA). Center for Environmental Research Information). Oct 1984. 131p. (EPA—625/1-81/013A). NTIS, PC A07/MF A01.

See also PB—88-189436.

This document is intended as a supplement to the 1981 Process Design Manual for Land Treatment of Municipal Wastewater (EPA/625/1-81/013). Throughout the document, the 1981 Manual will be referred to as the Manual. Part I in the text covers design of rapid infiltration systems, and Part II discusses overland-flow systems. A substantial amount of new information on both the concepts and their performance has been developed since 1980-81.

40016 **(PB—88-190913/XAB) Evaluation of the use of advanced information technology (expert systems) for database system development and emergency management in nonnuclear industries. Final report.** Rasmussen, J.; Pedersen, O.M.; Groenberg, C.D. (Risoe National Lab., Roskilde (Denmark)). Apr 1987. 95p. (RISO-M—2639). NTIS, PC E04/MF A01.

During recent years, a number of large industrial accidents have resulted in a widespread concern with organization of emergency services and means for effective support of the distributed organizations involved in emergency management. With the aim of presenting a discussion of the potential of modern information technology for decision support during accidents, the report brings a brief review of approaches to design of decision-support systems and expert systems. From the review it is concluded that models of decision support systems based on a control theoretic point of view, together with a cognitive approach to decision task analysis offer a suitable framework. In addition, it is concluded that Advanced Information-tools for data base design and for communication support in distributed decision-making should be considered for further development. A number of recent Danish industrial accidents are reviewed and key persons interviewed in order to give a preliminary basis for judging the feasibility of the theoretical discussion. The report includes a number of recommendations for further studies to support the development of a distributed data base system for emergency management.

40017 **(PB—88-192398/XAB) Public report for options to make the Toxic Release Inventory (TRI) data base accessible to the public.** (CRC Systems, Inc., Fairfax, VA (USA)). 4 Mar 1988. 68p. NTIS, PC A04/MF A01.

This paper presents appropriate options for implementation of a publicly accessible Toxic Release Inventory (TRI) data base, analyzes and evaluates the costs and benefits of those options, and recommends one or more of the best alternatives for making the TRI data base available to the public. The analysis addresses only the data-base options. It does not address other means of public access to TRI data, e.g., printed versions of the data or Freedom of Information Act (FOIA) requests, other than to note the potential effect of other means on usage of the data base.

40018 **(PB—88-195276/XAB) Computer assistance in hazards analyses and emergency planning.** Bare, J.C. (Environmental Protection Agency, Research Triangle Park, NC (USA). Air and Energy Engineering Research Lab.). Apr 1988. 15p. (EPA—600/D-88/075). NTIS, PC A03/MF A01.

This paper discusses computer assistance in hazards analysis and emergency planning. The Emergency Planning and Community Right-to-Know Act of 1986--Title III of the Superfund Amendment and Reauthorization Act (SARA)--requires facilities handling any of the designated chemicals--Extremely Hazardous Substances (EHSs)--in quantities greater than the Threshold Planning Quantities (TPQs) to submit information to their State Emergency Response Commissions (SERCs). Local Emergency Planning Committees (LEPCs) engage these facilities in planning and request information from the facilities that is necessary for planning. A user-friendly Macintosh computerized system was developed that allows LEPCs to handle the large quantities of data and assists them in analyzing the potential hazard of each chemical by assessing the severity of the consequences of a pre-planned release. The paper concentrates on hazards analysis for emergency planning for accidental releases of EHSs.

40019 **(PB—88-195896/XAB) Interactive environmental impact and economic analysis of the benefits of potable ground water on Cape Cod.** Edwards, S.F.; Solow, A.R. (Woods Hole Oceanographic Institution, MA (USA)). 1988. 26p. NTIS, PC A03/MF A01.

The goal of the project was to estimate the economic benefits of protecting potable ground water from nitrate contamination on Cape Cod, Massachusetts. The work consisted of three steps: estimating the public's total demand for clean water, taking supply uncertainty into account; estimating the probability of future nitrate contamination using historical data; and combining the results to arrive at an estimate of the overall economic benefits of ground water protection.

40020 **(PB—88-197611/XAB) Compilation of persons who design, test, inspect, and install storage-tank systems. Final report.** (Versar, Inc., Springfield, VA (USA)). 29 Feb 1988. 138p. NTIS, PC A07/MF A01.

The revised standards for the storage/treatment of hazardous waste in tank systems that were promulgated on July 14, 1986 (51 FR 25422) require owners/operators to use the services of professionally-trained and, in many cases, independent registered personnel, to perform various tasks related to tank system design and installation. To assist owners and operators in obtaining the needed services, EPA has compiled lists of individuals and companies who claim to provide one or more of the following services: (1) assessment of existing tank system integrity by an independent, qualified, registered professional engineer; (2) assessment of new tank system design by an independent, qualified, registered professional engineer; (3) determination of corrosion potential by an independent corrosion expert; and (4) inspection of installation of new tank systems by an independent, qualified installation inspector or an independent, qualified, registered professional engineer.

40021 **(PB—88-208186/XAB) Protecting health and safety at hazardous-waste sites: an overview.** (Environmental Protection Agency, Cincinnati, OH (USA). Center for Environmental Research Information). Sep 1985. 49p. (EPA—625/9-85/006). NTIS, PC A03/MF A01.

Cleanup operations at inactive hazardous-waste sites are now underway throughout the country. Thousands of workers are involved in the national effort. Because of the potential hazards inherent in such operations, an interagency committee, consisting of the National Institute for Occupational Health, the U.S. Environmental Protection Agency, the Occupational Safety and Health Administration, and the U.S. Coast Guard has developed guidelines for protecting worker health and safety at inactive hazardous-waste sites. This booklet summarizes those guidelines and presents key issues to consider in designing, implementing, or evaluating a health and safety program for work at inactive hazardous-waste sites. Much of the information is also relevant to planning for response to emergencies involving hazardous substances. The booklet is geared for nontechnical personnel.

2904 Natural Resources

REFER ALSO TO CITATION(S) 40173, 40618, 41377, 41390

40022 **(PB—88-197587/XAB) Office paper recovery: an implementation manual.** (SCS Engineers, Inc., Long Beach, CA (USA)). 1977. 60p. NTIS, PC A04/MF A01.

The manual gives pictorial and factual information to aid Federal government personnel who are responsible for implementing and administering office-source separation programs in accordance with the high-grade waste-paper-recovery requirements of the guidelines.

40023 **(PB—88-198718/XAB) United Kingdom mineral statistics: data to 1985.** Squirrell, H.C.; Haslam, H.W.; Fellows, M.E. (British Geological Survey, Keyworth). 1987. 178p. NTIS, PC E09/MF E09.

See also PB—86-245669.

This edition is the thirteenth in the annual series of United Kingdom Mineral Statistics, which was first published in 1973. In one volume it presents minerals production, consumption, import and export data obtained from a wide variety of published and unpublished sources. Compared with the preceding edition, all the contents are systematically updated by one year and revisions for earlier years are made wherever more up-to-date information has become available. Minor improvements and additions are made to tables in the Commodity Summaries section, and estimates of apparent consumption are given for seven metals for which there are no reported statistics, namely: chromium, cobalt, manganese, molybdenum, titanium, vanadium, and zirconium.

2905 Research, Development, Demonstration, And Commercialization

REFER ALSO TO CITATION(S) 39114, 39120, 39539, 39986, 40007, 40009, 40077, 40082, 40139, 40176, 40238, 40634, 41311, 42456

40024 **(AD-A—190944/9/XAB) Amended FY 1988/1989 biennial budget justification of estimates submitted to Congress.** (Defense Advanced Research Projects Agency, Arlington, VA (USA)). Feb 1988. 97p. NTIS, PC A05/MF A01.

See also AD-C042 262.

The Defense Research Sciences Program element provides the technical foundation for long-term improvements in military equipment and systems through the discovery of new phenomena and the exploration of the potential of such phenomena for military application. Projects CCS-02, Advanced Digital Structures and Network Concepts, ES-01, Electronic Sciences, and MS-01, Materials Sciences in the Program Element are discussed in the individual project descriptions. The Modernization Technology Project is developing inexpensive, tethered platforms for rapid elevation of sensors and communications antennas from tactical vehicles. The Geophysical Research Project aims to improve yield determination of Soviet underground nuclear explosions and discrimination of earthquakes, quarry blasts, and decoupled underground nuclear explosions. The Systems Sciences Project involves research in the following areas: Advanced biosensor design/fabrication; very large scale integrated (VLSI) neural net chip fabrication; bio-organic materials for advanced sensor applications and naval countermeasures exploitation; advanced applied mathematical techniques for clustering algorithms to distinguish different emitters - radar, anti-submarine warfare (ASW), dense electronic warfare (EW); automatic personal computer system for high-speed exact-image compression and regeneration; and adaptive vehicle technology. Under the Armor Materials Research Project, research is performed to support all aspects of the Armor Program in program element number 0602702E, Tactical Technology.

40025 **(AD-A—191842/4/XAB) Department of Defense report on the merit-review process for competitive selection of university research projects and an analysis of the potential for expanding the geographic distribution of research for the committees on appropriations, United States Congress.** (Department of Defense, Washington, DC (USA)). Apr 1987. 33p. NTIS, PC A03/MF A01.

This report responds to the Committee on Conference request, DoD Appropriations Act, 1987 as set forth in the following. With the establishment of the University Research Initiative in fiscal year 1986 and rising funds for the Strategic Defense Initiative, the Department of Defense's investment in university-based research is increasing. Consequently, the appropriations committees need to ensure that the peer-review process for the allocation of university funding is working effectively, and that mechanisms are in pace to broaden the base of DoD university research commensurate with these increasing resources. Therefore, the conferees direct the Department of Defense to submit a report to the appropriations committees by March 1, 1987, which (1) explains in detail the current peer-review process in a step-by-step fashion; (2) explains current participants in this process, including peer-review panels, boards, or conferences, and how such peer reviewers are evaluated and chosen; and (3) an analysis of the potential for expanding the research base into geographical areas which at the present time receive little defense-related university funding. This report explains DoD's merit-review process and the participants in that process and also describes the current distribution of DoD research funding to universities and the potential for geographic expansion.

40026 **(ARE—CRNL2551) Funding of Canadian energy research and development, 1981-1982.** Bancroft, A.R.; Dixon, R.S. (Atomic Energy of Canada Ltd., Chalk River, Ontario). Jul 1983. 32p. (CE—01525). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

This report assembles information on energy research and development spending in Canada, as a base for reviewing Atomic Energy of Canada's own programs in the center of national priorities and realities. During fiscal year 1981-1982 Canada spent almost $720 million on energy research and development. Private industry spent 46% of the total, provincial governments 22%, and the federal government 32%. Spending on oil sands, heavy oil and coal accounted for 30% of the total, oil and gas 18%, nuclear fission 17%, conservation 10%, renewables 8% and all other categories 17%. 1 fig., 13 tabs.

40027 **(DOE/ER—0361) A review of the exploratory research and development programs at the five multiprogram energy laboratories.** (USDOE Office of Energy Research, Washington, DC. Office of Program Analysis). Jun 1988. 94p. NTIS, PC A05/MF A01;1; GPO Dep. Order Number DE88012407/JAW.

The Office of Program Analysis completed a review of the first four fiscal years of the Exploratory R&D program's implementation. The review focused on Argonne National Laboratory, Brookhaven National Laboratory, Lawrence Berkeley Laboratory, Oak Ridge National Laboratory, and Pacific Northwest Laboratory. The purposes of the review were to catalogue all program expenditures and characterize the use of resources, portray the various processes used to select projects and identify the selecting officials, review the availability of program documentation, and, document each Laboratory's program in sufficient detail to reveal all the salient aspects of the program's operation. A comprehensive list of program expenditures was compiled. The expenditure data, on-site visits, and written descriptions of program procedures, which were reviewed and validated by the Laboratories, formed the basis for the following findings.

40028 **(GAO/IMTEC—88-2) Software distribution: Review of the Department of Energy's National Energy Software Center.** (General Accounting Office, Washington, DC (USA). Information Management and Technology Div.). 1987. 35p. General Accounting Office, PO Box 6015, Gaithersburg, MD, 20877.

The National Energy Software Center manages and controls the transfer of computer software to other governmental agencies, the private sector, and foreign recipients. This report provides information on the Center's top 30 computer programs; program categories; records of distribution by foreign recipients to other countries; records of the domestic or foreign recipient's improvements of software distributed by the Center and whether this leads to commercialization; computer programs the Center shipped to Italy in recent months; and computer programs that are contained in the Center's more sensitive categories and those that have been shipped to foreign requests in recent months.

40029 **(GAO/RCED—87-147) Energy management: DOE/Martin Marietta earnings limitation agreement.** (General Accounting Office, Washington, DC (USA)). 1987. 33p. General Accounting Office, PO Box 6015, Gaithersburg, MD 20877.

The Department of Energy and Martin Marietta Corporation recognized the existence of organizational conflict of interest relating to Marietta's Energy Systems' transferring a DOE-devel-

oped technology to an affiliate known as the Tennessee Innovation Center for commercialization. They began negotiating an agreement to limit Martin Marietta's return from certain Innovation Center investments. The agreement may not accomplish its intended purpose because (1) Martin Marietta could retain substantial returns on its investment - through the Innovation Center - in companies involved in commercializing DOE technologies and (2) it lacks enforcement and effective monitoring provisions.

40030 **(PB—88-183769/XAB) Role for the federal laboratories in rebuilding America's competitive edge. Final report.** (National Research Council, Washington, DC (USA). Commission on Engineering and Technical Systems). Mar 1988. 36p. NTIS, PC A03/MF A01.

The document reports the key findings of a three-day conference, held in June 1987, on the transfer of technology from federal laboratories to private industry. The major theme of the report is that effective technology transfer is a collaborative, cooperative process, not simply the transfer of a product. The process is best managed by (1) actively identifying both the technology needs of industry and the technology development capabilities of laboratories, and (2) mediating these needs and capabilities to ensure that the resources available to develop new technologies are focused on the most urgently needed and readily accepted problems. In applying these concepts to the federal laboratories, the conference participants concluded that research directors should keep abreast of industrial needs and actively market the capabilities of federal laboratories to meet those needs.

40031 **(PB—88-925900/XAB) Tech notes. Monthly report.** (National Technical Information Service, Springfield, VA (USA)). 1988. vp. NTIS Subscription.

Supersedes PB—87-925900; Paper copy available on subscription, North American Continent price $127.00/year; all others write for quote. Single copies also available.

Tech Notes is a monthly compilation of fact sheets of new technology developed by Federal agencies and their contractors. Each issue is divided into easy-to-scan sections covering: agriculture and food, computers, electrotechnology, energy, life sciences, machinery, engineering, manufacturing, materials, medicine and biology, physical sciences and testing and instrumentation. More than 120 fact sheets are provided in each issue.

2906 Nuclear Energy

REFER ALSO TO CITATION(S) 39242, 39245, 39285, 39306, 39318, 39343, 39345, 39346, 39347, 39350, 39382, 39399, 39406, 39429, 39969, 39980, 40079, 41132, 41135, 41241

40032 **(AD-A—191786/3/XAB) Evaluation of the targeted enlistment bonus (TEB) for Nuclear Field recruits. Final report.** Cooke, T.W. (Center for Naval Analyses, Alexandria, VA (USA). Naval Planning Manpower and Logistics Div.). Oct 1987. 45p. (CRM—87-137). NTIS, PC A03/MF A01.

This research memorandum contains the last of three evaluations of the Targeted Enlistment Bonus (TEB) for Nuclear Field recruits. The TEB differs from previous enlistment bonuses by varying the bonus amounts according to the season a recruit begins active duty. Historically, Nuclear Field accessions have been characterized by a seasonal surge in the summer months, reflecting the presence of many Nuclear Field recruits for beginning service shortly after obtaining a high school diploma. The TEB is designed to assist recruiters in achieving a more-level flow of accessions during the year. It was tested during the 18-month period from October 1985 through March 1987. For the evaluation, Nuclear Field recruits during this period are compared to those of previous years in terms of the phasing of accessions and enlistment contracts, and indicators of recruit quality. Savings associated with the TEB experiment are calculated, and implications for potential changes in the TEB are drawn.

40033 **(FRADOC—12-1) Targets and criteria for the effective participation of national industry in a domestic nuclear power programme.** Py, J.P. (Societe Franco-Americaine de Constructions Atomiques (FRAMATOME), 92 - Courbevoie (France)). 1986. 48p. (In French). (IAEA-SR—124; CONF-860419—). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88752425/JAW.

From Seminar on supporting industrial infrastructure requirements and development for nuclear power; Vienna, Austria (14 Apr 1986).

The interest in maximum use of national resource is common to all countries, the highly industrialized as well as the developing ones. Although benefits can be expected from national participation in a domestic nuclear power programme and may not be limited to this programme, such national participation is restricted by constraining factors: economic, financial, technical and political. Considering the various natures of activities - design, procurement, manufacturing, erection -, their technical difficulties, their potential spin-off effects on the overall industrial development of a country, the paper reviews the materials and components of a nuclear power plants which can be selected as targets for domestic production. The paper also reviews criteria which must be considered in setting these Target materials and components in order to overcome restricting factors to national participation such as cost of national products, financing, investment capability, adequate market size, availability of qualified manpower, industrial capability and quality standards, availability of technology and know-how, conflicts of interests. Some concrete examples drawn from previous experience will illustrate France efforts to overcome these limiting factors.

40034 **(INIS-BR—946) Nuclear energy in Brazil.** Menegassi, J. (Comissao Nacional de Energia Nuclear de Brasil, Rio de Janeiro). Jun 1986. 68p. (In Portuguese). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88701601/JAW.

A brazilian overview about the uses of nuclear energy is presented. A study is made since the electricity generation to the environmental impacts. (E.G.).

40035 **(INIS-mf—11097) Collection of the institute's papers 1985.** (Vyzkumny Ustav Palivoenergetickeho Komplexu, Prague (Czechoslovakia)). 1986. Vp. (In Slovak). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88780069/JAW.

This collection contains papers produced for the institute in 1985. These individual contributions have been abstracted separately. (DWL)

40036 **(INIS-mf—11698) Possibilities of electricity generation in Schleswig-Holstein without using nuclear power.** Fischer; Kohler; Natsch; Rossnagel; Sailer. (Institut fuer Angewandte Oekologie e.V., Freiburg im Breisgau (Germany, F.R.)). Oct 1986. 276p. (In German). NTIS (US Sales Only), PC A13/MF A01. Order Number DE88753805/JAW.

The study is arranged in three main parts: Part A discusses safety reasons for backing out of nuclear energy utilisation, and the current legal situation and available scope of action. Part B investigates the technical feasibility of an immediate, complete reactor shut-down in Schleswig-Holstein (in 1987). Part C deals with the framework conditions of a nuclear power shut-off and with accompanying measures on the energy market. According to the order, the main goal of the study was to prove that a nuclear power shut-off is technically feasible. So this study presents assessments with a view to technical feasibility, legal scope of action, costs, ecological effects, and alternative strategies for efficient energy policy on the Land level. This relatively restricted framework, considering exclusively the possibilities of the Land Schleswig-Holstein, necessarily brings about a reduction of the scope of action or optimisation. It is therefore recommended to have an analysis prepared that considers the country as a whole, in order to enhance perspectives and the scope of action. The study does not deal with aspects such as political acceptability and feasibility, or concrete legal processes or procedural steps that would have to be taken in case of backing out and making the turn in energy. The study to a great part relies on

assumptions and framework conditions defined in another study by the authors Mueller-Reissmann and Schaffner, entitled 'Power generation without nuclear energy - consequences of backing out of nuclear power'. A brief summary of this study is given in the appendix to the study in hand. (orig./UA)

40037 **(NUREG—0750-Vol.27-Index-1) Indexes to Nuclear Regulatory Commission issuances, January-March 1988.** (Nuclear Regulatory Commission, Washington, DC (USA)). 1988. 42p. NTIS, PC A03 - GPO;3. Order Number TI88012256/JAW.

Digests and indexes for issuances of the Commission (CLI), the Atomic Safety and Licensing Appeal Panel (ALAB), the Atomic Safety and Licensing Board Panel (LBP), the Administrative Law Judge (ALJ), the Directors' Decisions (DD), and the Denials of Petitions of Rulemaking are presented in this document. These digests and indexes are intended to serve as a guide to the issuances. Information elements common to the cases heard and ruled upon are: Case name (owner(s) of facility); Full test reference (volume and pagination); Issuance number; Issues raised by appellants; Legal citations (cases, regulations, and statutes); Name of facility, Docket number; Subject matter of issues and/or rulings; Type of hearing (for construction permit, operating license, etc.); and Type of issuance (memorandum, order, decision, etc.).

2908 Waste Heat Utilization

REFER ALSO TO CITATION(S) 40040

40038 **(DOE/CE/26523—T1) Franklin County, Kentucky District Heating and Cooling Assessment Program: Final report.** (Kenvirons, Inc., Frankfort, KY (USA); Grier (W.F.) and Associates, Inc., Lexington, KY (USA); Kaiser-Taulbee Associates, Inc., Lexington, KY (USA)). Dec 1987. Contract FG01-85CE26523. 52p. NTIS, PC A04/MF A01;1; GPO Dep. Order Number DE88010797/JAW.

Findings and Conclusions: (1) A waste-to-Energy District Heating and Cooling project using the solid waste generated in Franklin County to provide heat for certain major state office building complexes and co-generation of electricity is economically feasible. (2) The proposed project would provide a stable, long-term, cost predictable alternative for solid waste disposal for the County and City of Frankfort. It would also tend to stabilize the long-term cost of heating State office complexes. (3) The project can economically provide heating energy to selected State building complexes, but does not appear to be able to economically provide cooling energy to these complexes. The energy that can not be used for heating can best be marketed as electric energy. (4) Interest rates on bonds and other financial instruments are lower now than they have been in recent years and future rates are predicted to be even lower, thereby making the project more attractive. (5) Based on current (1987) energy prices and landfill disposal costs, the project may not be economically self sustaining for the first few years. (6) In order for the project to be successful, broad public support is necessary. This support can be achieved by including on the policy-making board of the project, representatives of the major segments of the community that have an interest in it. (7) There are a number of organizational structures under which the project could be built and operated. (8) Irregardless of what form or structure the project takes, it is complex and will take the cooperation of a large number of interest groups.

2910 Conservation

REFER ALSO TO CITATION(S) 40005, 40209, 40214, 40220

40039 **Evaluating the impact of two energy conservation programs in a midwestern city.** Brown, M.A.; Macey, S.M. (Oak Ridge National Lab., TN (USA)). *Applied Geography (European American Nuclear Data Committee);* No. 5, 39-53(1985).

This paper presents a general methodology for evaluating energy conservation programs, and uses the methodology to assess a home audit and an energy tax credit program. The data base contains utility bill histories, audit forms, and personal surveys for 319 Decatur, Illinois homeowners. These data enable analysis of the extent of adoption of the two programs; characteristics of adopter and non-adopters; the role of information in the adoption process; the actions prompted by the programs; and the impact of the programs on residential energy consumption. Those who adopt programs are found to be better educated, wealthier, have new homes, and engage in more conservation practices. Lack of information is one barrier to program adoption, with adopters receiving more useful information from the local utility company and government sources. The programs appear to have prompted certain conservation practices, but they have not reduced energy consumption. Policy implications are discussed.

2920 Supply, Demand, And Forecasting

REFER ALSO TO CITATION(S) 39209, 39531, 39999, 40051, 40056, 40069, 40070, 40079

40040 **(DOE/EIA—0202(88/2Q)) Short-term energy outlook: Quarterly projections.** (USDOE Energy Information Administration, Washington, DC. Office of Energy Markets and End Use). 9 May 1988. 52p. NTIS, PC A04 - GPO;3. Order Number DE88010701/JAW.

The short-term outlook for overall growth in the domestic economy is less bleak than reported in January 1988, thanks, in part, to several months of relatively encouraging news about consumer confidence. Despite some recent disquieting trade news, a continuing improvement in the trade situation is expected. The prospects for adverse consequences stemming from the October 1987 stock market crash have been discounted. Current excess crude oil stocks, weak demand for petroleum worldwide, and continued overproduction by OPEC have resulted in declining oil prices at the outset of the current forecast and good prospects for continued price weakness over the next two years. 19 figs., 20 tabs.

40041 **(DOE/EIA—0383(87)) Annual energy outlook, 1987: With projections to 2000.** (USDOE Energy Information Administration, Washington, DC. Office of Energy Markets and End Use). 28 Mar 1988. 66p. NTIS, PC A04/MF A01;1; GPO Dep. Order Number DE88009297/JAW.

Except for greater promise from both domestic crude oil and natural gas, the long-term trends depicted in this year's AEO are essentially unchanged from the 1986 view. In the latest base-case projections, the economy is assumed to grow at an average rate of 2.2% per year from 1987 through 2000—somewhat below the 2.4% growth assumed last year; and real oil prices on the world market (expressed in 1987 dollars) remain below $20 per barrel until 1994. Thereafter, increasing world oil demand is expected to begin absorbing excess supply, so that oil prices should then increase more rapidly—reaching $31 by the year 2000. In the near term, most energy markets—including those for natural gas, coal, and electricity, as well as oil—must continue to cope with excess production capacity. In the longer term, as this excess capacity is diminished, prices are expected to rise moderately. Such price movement will reflect the increasing need to develop resources as an expanding economy produces greater demand that must be anticipated and met. 16 figs., 40 tabs.

40042 **(EFG—041987) Energy security for Prince Edward Island.** (Department of Energy and Forestry, Charlottetown, Prince Edward Island (Canada)). Apr 1987. 16p. (MICROLOG—88-01865). Prince Edward Island Dept. of Energy and Forestry, Shaw Bldg., 105 Rochford St., PO Box 2000, Charlottetown, P.E.I., Canada C1A 7N8; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

Prince Edward Island is rightly concerned about the security of its energy supplies, since it has virtually no energy sources of its own and must depend on oil and electricity imported from outside the province. This report is concerned about meeting this challenge and discusses action that should be taken in five areas. The first area, the need to alleviate the threat of energy shortages, is evident in that nearly 80% of the Island's energy needs are met by crude oil, most of which comes from foreign imports. There is little

the province can do by itself besides encouraging conservation, alternate sources, and proper federal policies. Similar threats of shortages occur with electricity, 99% of which comes via one underwater cable from New Brunswick. The second area is the need to alleviate the threat of price shocks for oil and electricity, in which government policies play an important role. The third area is the need to increase access to energy options; this is being addressed by current investigation into solar, wind, and biomass technologies, for which the greater adaption of wood fuels appears to be the most promising. The other two areas covered in this report are the need to improve management of energy demand and the need to ensure fair regulatory treatment at all levels of government which will recognize the Island's unique situation. 1 fig., 1 tab.

40043 **(EPRI-EM—5767-Vol.1) DSM [Demand-Side Management] Customer Response: Volume 1, Residential and commercial reference load shape and DSM impacts: Final report.** McDonald, C.; Caves, D.; Herriges, J.; Windle, B.; Kirksey, W.E. (Electric Power Research Inst., Palo Alto, CA (USA); Synergic Resources Corp., Bala-Cynwyd, PA (USA); Christensen (Laurits R.) Associates, Inc., Madison, WI (USA); Battelle Columbus Div., OH (USA)). Jun 1988. 335p. Unlimited audience, publicly available. Research Reports Center, Box 50490, Palo Alto, CA 94303;1. Order Number TI88012237/JAW.

Customer Response is the analysis of the load shape changes that result from the implementation of Demand-Side Management (DSM) alternatives. This effort developed data bases and analytical tools for the analysis of customer response. A data base of end-use load shapes for the residential and commercial sectors was developed from end-use metering studies and engineering simulations. The data base includes load shapes for different climate zones and technology options. Models were also developed, based upon empirical results, for predicting customer response to alternative rate structures. An overall system was developed for analysis of Customer Response including: reference data base of end-use load shapes for different climate zones and technology alternatives; mechanisms for adjusting the load shape data for local utility characteristics; models for estimating end-use load shapes from whole building load data; methods for reconciling end-use load data with class and/or system load data; data and guidelines for estimating customer response to alternative technologies; and models and guidelines for estimating customer response to rate and educational programs. The different models and data, developed as part of this effort, are appropriate for use by utilities with differing amounts of available, local data and analytic requirements. User friendly, IBM-PC compatible software was developed that allows the analyst to easily use the data and techniques that were developed. 98 refs., 39 figs., 47 tabs.

40044 **(UCID—19227-87) US energy flow, 1987: Energy program report.** Borg, I.Y.; Briggs, C.K. (Lawrence Livermore National Lab., CA (USA)). May 1988. Contract W-7405-ENG-48. 21p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88011761/JAW.

Energy use in 1987 increased by 3%. All end-use sectors experienced modest growth including transportation which increased for the fifth consecutive year despite improved average mileage of the automotive fleet. Oil imports increased again in 1987 while domestic crude oil production declined. The value of gross imports of crude oil and petroleum products (in 1982 dollars) comprised 14% of total US imports of durable and non-durable goods in both 1986 and 1987. Electrical sales rose by 3.3% thus exceeding projections of almost all forecasters. Non-utility generation of power, some of which is sold to the utilities by cogenerators, contributed about 4% to the whole; however it is completely assessed since some or all of the power is used by the self-generators themselves. Regulatory changes under discussion in 1987, anticipated regional shortages, and the inability of many utilities to finance large base-load plants promise to encourage the growth of non-utility generation in the next decade. 16 refs., 6 figs., 5 tabs.

40045 **(UCLDE-DP—87-14) Modelling energy demand and household welfare using micro-data.** Baker, P.; Blundell, R.; Micklewright, J. (University Coll., London (UK). Dept. of Economics). 1988. 71p. British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks.

Discussion papers in economics.

The paper is concerned with the empirical modelling of domestic demand for energy in the UK at the level of the individual household. A two-stage budgeting model of household demand for energy conditional on durable ownership is developed. The second stage allocation is assumed to be between gas, electricity and a composite good other fuels which is subject to such measurement error in the data set concerned that it is treated as unobserved. Some simplifying assumptions lead to linear estimating equations for gas and electricity and it is shown how structural parameters can be identified for use in the calculation of welfare gains and losses of price changes. Estimation takes place using a sample of over 50,000 households drawn from the annual Family Expenditure Survey (FES) for the years 1972-1983. Unrestricted reduced form estimates are presented and the diversity of implied price and income elasticities is emphasised. Both gas and electricity are found to be inferior for over half the sample.

2930 Policy, Legislation, And Regulation

REFER ALSO TO CITATION(S) 39189, 39245, 39285, 39318, 39343, 39345, 39352, 39382, 39406, 39696, 39718, 39782, 39866, 39948, 40042, 40165, 41394, 42453

40046 **(EMR—1988) The Canada-US Free Trade Agreement and energy. An assessment.** (Department of Energy, Mines and Resources, Ottawa, Ontario (Canada)). 1988. 104p. (In English and French). (MICROLOG—88-02223). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1. $0.34 CAN per page, $3.40 minimum; MF $10 CAN.

The Canada-US Free Trade Agreement will establish a new trading relationship based on more secure and more open access to each other's markets. The most immediate impacts on the energy sector will mainly occur in the oil, uranium and electricity sectors. In the longer term, the intangible and indirect impacts are likely to be considerably more important. The more secure access to the US market will make the energy sector's realization of its potential to generate revenues and create jobs throughout Canada more likely. Enhanced investor confidence, due to creation of a more stable trading environment, will assist Canadian energy resource development. By improving the prospects for obtaining the economies of scale that can be obtained by access to US markets, the Agreement could facilitate the development of certain megaprojects. Canada's energy security will not be compromised, and there will be no significant impact on domestic energy prices. While the Agreement does not preclude a Canadian regulated price for oil and gas which is less than the world price, it does make such a policy less attractive. While there is nothing in the Agreement that precludes governments from setting domestic energy prices higher than export prices, the Agreement constrains Canada's ability to use import controls on US energy imports to achieve such an objective. Artificially low or high energy prices distort decision making possibly to the detriment of overall economic growth. Under the current market-based energy pricing system, domestic prices will tend to equal export prices. The Agreement is thus consistent with the way Canadian energy pricing policy has been evolving. 4 figs., 7 tabs.

40047 **(INIS-mf—11226) International Atomic Energy Agency: activities and relationship with Mexico.** Abud Osuna, J. (Universidad Nacional Autonoma de Mexico, Mexico City. Facultad de Ciencias Politicas y Sociales). 1987. 122p. (In Spanish). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88703053/JAW.

Legal and political studies on the activities of the IAEA infer that the pacific uses of nuclear energy become more significant every day in the ambit of international relationships. The studies analyze as a whole relationships among member states. The first part is divided into four chapters, starting with the background and creation of the agency, its structure, statutes, amendments and the performance of its main organisms. It continues to describe mechanisms and programmes carried out, including cooperation agreements between the IAEA and other specialized organizations in the United Nations. It ends up with the IAEA performance resulting from different treaties. The second part examines Mexican norms

on nuclear matter as well as relationships between Mexico and the IAEA. It demonstrates that achievements in the Agency have been possible because of the establishment of an international cooperation basis, which avoids duplicity of actions. The conclusions recommend joint efforts from both the developed and the developing countries in the following: a) to imbue public opinion with the goodness of nuclear energy; b) to discourage the construction and operation of nuclear installations; c) to unify national standards on nuclear safety and control; d) to decrease export restrictions, based on safeguards; e) to promote internal nuclear research in Mexico or throught regional integration agreements, with technical assistance and support from the IAEA.

40048 **Policy analysis in theory and practice.** Wilbanks, T.J.; Lee, R. (Oak Ridge National Lab., Oak Ridge, TN (US)). pp 273-304 of Large scale energy projects: Assessment of regional consequences. Lakshmanan, T.R.; Johansson, B. New York, NY; Elsevier Science Pub. Co. Inc. (1985).

People who do policy analysis believe that science can help make policy better, to the larger benefit of society. Attracted by any change to link technical skills with the impulse to be useful, the authors have spent a major part of their professional lives trying to make this happen. They know that a lot of the effort goes for naught. Even worse, some of it gets misused by the policy-making process in the pursuit of policies that we believe misguided. Many of us are frustrated by this gap between aspiration and reality in what we do - together with our conviction that the gap is usually contrary to the public interest. In IIASA's terms, we sense the existence of a "universal" problem here and, by pooling our experience, we hope to find some avenues that offer us real prospects of solving it. As a rather tentative step in such a direction, this chapter starts by very briefly reviewing policy analysis as an ideal and indicating how this idea is manifested in the five case studies. It then considers the "real world" of policy analysis - how the process usually works in practice - and how this process differs from the ideal, using the case studies as examples. Finally, it suggests some directions for closing the gap between theory and practice in policy analysis.

2940 Fossil Fuels

REFER ALSO TO CITATION(S) 39104, 39114, 39116, 39126, 39160, 39161, 39162, 39166, 39169, 39175, 39205, 39207, 39209, 39210, 39217, 39222, 39222, 39223, 39995, 40003, 40040, 41244, 42456

40049 **(C—TP3347F) Potential market of propane as a fuel in road vehicles in Quebec. Final report.** (Cogesult, Montreal, Quebec (Canada)). Mar 1981. 92p. (In French). (CE—01677). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

The development of the market for conversion of road vehicles to propane has been an attractive energy option in Canada. This report investigates the conditions of the development of this market in Quebec. At present, the difference in price between propane and gasoline is insufficient to make conversion economically attractive for fleet operators interviewed in this study. To this factor is added the legislative obstacle relating to school buses and to transport of dangerous materials through tunnels in the Montreal area. If the economic and legislative context continues, it is concluded that the propane market will not develop in Quebec in the next fifteen years as it would otherwise. In the hypothesis where incentive measures for propane conversion are adopted, it is believed that the fuel market could reach, above all in private commercial fleets, up to 3,000 bbl/d of propane in 1995, or, in the most favorable context, 5,000 bbl/d (i.e. around 50% of present traditional market consumption). These relatively conservative estimates are at any rate subject to the potential penetration of diesel fuel. The key element to initiating conversion, other than proof of economic advantages, remains the dissemination of information on performance and safety of propane use. The impact of market penetration of propane on the existing fuel distribution network is forecast to be small, mainly in the area of some new storage facilities in the busiest regions of Quebec. Imports of propane from other provinces are forecast to decrease to 1978 levels. 2 figs., 39 tabs.

40050 **(DOE/PE/16037—T2) Background analyses and review of the draft environmental impact statement supplement for the Federal Coal Management Program.** (Eastern Research Group, Cambridge, MA (USA)). 5 Mar 1985. Contract AC01-84PE16037. 79p. NTIS, PC A05;3. Order Number DE88012309/JAW.

This document presents a review of the Draft Environmental Impact Statement supplement for the Federal Coal Management Program. It describes the purpose of the Draft EIS Supplement in the context of the Federal Coal Management Program, and develops a substantive evaluation of the technical issues covered. This review is organized to provide an initial orientation to the Federal Coal Management Program, and then to thoroughly review the new environmental document. Section 1.0 below presents a recent history and a description of the Federal Coal Management Program. Section 2.0 provides a summary of the format and content of the Draft EIS Supplement. General and issue-specific critiques are presented in the Sections 3.0 and 4.0, respectively. Appendix A presents a further examination of the environmental aspects for the Federal Coal Management Program. 11 refs., 11 tabs.

40051 **(GAO/NSIAD—87-159BR) International Energy Agency: Assessment of U.S. participation in the fifth allocation system test.** (General Accounting Office, Washington, DC (USA)). 1987. 77p. General Accounting Office, PO Box 6015, Gaithersburg, MD 20877.

The possibility of a serious oil supply disruption led to creation of the International Energy Agency by the major oil consuming nations. One of IEA's objectives is to reduce the consequences of serious supply disruptions by sharing shortfalls. This report reviews U.S. participation in the most recent test of IEA's emergency oil sharing system. It examines how the test was designed and how well its objectives were met; it assesses U.S. participation and performance; and it evaluates the extent to which the oil sharing system and U.S. participation in it meaningfully exercised U.S. energy emergency preparedness plans and provided useful training.

40052 **(GAO/RCED—86-85) Petroleum products: Effects of imports on U.S. oil refineries and U.S. energy security.** (General Accounting Office, Washington, DC (USA)). 1986. 73p. General Accounting Office, PO Box 6015, Gaithersburg, MD 20877.

U.S. crude oil refining capacity would likely be sufficient to process domestic crude oil and crude imports if an oil emergency occurred at the present time. As an indication of future emergency refining capabilities, U.S. capacity would also likely be sufficient to refine domestic supplies if a disruption occurred in 1990. A tariff or quota would shift billions of dollars annually from consumers to crude producers and/or refiners and, in the case of a tariff, to the government. Consumers and the economy would benefit from a tariff or quota.

40053 **(GAO/RCED—87-126) Alternative fuels: Parachute Creek shale oil project's economic and operational outlook.** (General Accounting Office, Washington, DC (USA)). 1987. 69p. General Accounting Office, PO Box 6015, Gaithersburg, MD 20877.

The Department of Energy awarded the Union Oil Company $400 million in price guarantees for synthetic crude oil produced by Parachute Creek shale oil project in Colorado. In 1985, Synthetic Fuels Corporation awarded an additional $500 million in price and loan guarantees to Union to modify the project's technology with a fluidized bed combustor. In December 1985, the Congress abolished SFC and transferred responsibility for the guarantees to the Treasury. GAO believes that because of the uncertainty of the project's economic and technical viability, it would not be in the government's best interest to expand an additional $500 million in financial assistance to install the combustor. If Union elects to proceed with the combustor, GAO recommends that Treasury use the analysis in this report to critically evaluate Union's proposal and explore the government's options for minimizing additional outlays on the project.

40054 (GAO/RCED—87-207BR) **Mineral revenues: Interior's control over oil and gas allowances.** (General Accounting Office, Washington, DC (USA). Resources, Community and Economic Development Div.). 1987. 27p. General Accounting Office, PO Box 6015, Gaithersburg, MD 20877.

Interior's Mineral Management Service's method of controlling gas allowances has three parts: prior approval of allowances that companies expect to claim; computerized comparison of allowances approved with allowances claimed; and audits to verify the validity of allowances deducted. MMS uses only prior approval of allowances and audits, and these have had limited scope and effectiveness. MMS has initiatives underway that can affect control of allowances claimed - new product value regulations and computerized monitoring to identify claimed allowances that warrant further review. Because these actions have not been implemented, GAO doesn't know how MMS' controls on allowances will be affected.

40055 (HE—TP2709) **Fuel supply for diesel locomotives.** (Hycarb Engineering Ltd., Calgary, Alberta (Canada)). Oct 1980. 81p. (CE—01363). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

This study examines the petroleum refining industry in Canada and its ability to adjust operations to continue to supply the marketplace demands for petroleum products, and in particular for railway diesel. The study also addresses future refinery modifications and expansions and possible compromises in product quality. A forecast of petroleum product demand and crude oil availablility, through to 1990, was established. The pertoleum refining industry was then analyzed as to its ability to adjust operations to meet the future demands. As an aid in the refinery analysis, a linear programming model was utilized to simulate the refining industry on a regional basis. In western Canada, there is a near-term shortage in refining capacity, with diesels forecast to be in tightest supply. In the east, the short-term situation is tight but manageable, with ample crude running capacity but insufficient processing flexibility. The problem seems to be one of balance in the middle distillate pool with forecast shortages of high quality diesel, A consumer such as the railways could alleviate this problem by using a lower grade diesel. By accepting a lower quality fuel, the railways tie themselves into a special product which would not be under the same market pressures as high quality diesel. To use this fuel may require changes in marketing, distribution, and fueling systems, and in the locomotives themselves, but the cost of these changes may be lower than the alternatives such as imports or refinery processing additons. 11 figs., 31 tabs.

40056 (OME—031987) **Guidelines for the preparation of municipal oil shortage contingency plans.** (Ontario Ministry of Transportation and Communications, Ottawa (Canada)). Mar 1987. 69p. (MICROLOG—88-02213). Ontario Ministry of Energy, Municipal and Commercial Programs, 56 Wellesley St., West, Toronto, Ont., Canada M7A 2B7; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

The guidelines given in this document have been prepared to assist Ontario municipalities in the preparation of oil shortage contingency plans. The guidelines are genetic in nature and apply to all types of municipal organizations, including villages, towns, townships, cities, counties and regional municipalities. The guidelines should be read in conjunction with completed municipal oil shortage contingency plans, which demonstrate how different municipal structures have undertaken oil shorage contingency planning. The application of these guidelines will result in the preparation of a detailed oil shortage contingency plan. Such a plan should include documentation on coordination and communication among those responsible and should identify energy demand restraint measures in the areas of municipal services and operations, public transit (if applicable), and community outreach to promote voluntary restraints during the emergency. A work program is outlined, detailing how to identify and calculate the parameters needed to be known, such as fuel consumption and transportation patterns. Realistic implementation measures, applicable to the municipality in question, are recommended. Testing, reviewing, and establishment of legal authority of the plan are also considered. 79 refs., 2 figs., 4 tabs.

40057 (OSTF—081987) **Alberta: our future is oil sands.** (Oil Sands Task Force, Edmonton, Alberta (Canada)). Aug 1987. vp. (CE—01635). Alberta Chamber of Resources, 10235 - 101 St., Ste. 1410, Edmonton, Alta., Canada T5J 3G1; $N/C.

This report is a compilation of three separate reports regarding resource activity in the Alberta oil sands. A brief comment on tax reform is included. One paper from this report has been abstracted.

40058 (OSTF—081987, pp 10) **Energy security for Canada: the oil supply option.** Aug 1987. Oil Sands Task Force, Edmonton, Alberta, Canada. (CE—01635).

In Alberta: our future is oil sands.

Canada faces increasing dependence on imported crude oil if major new domestic sources of supply are not developed. Federal and provincial governments have recognized the risk this situation poses for oil supply security and have emphasized the need to develop national solutions. Canada possesses abundant indigenous oil resources in the offshore and oil sands. Any significant additions to Canada's light crude supply must come from these areas. By themselves, the costs of these developements are not insurmountable. And, in contrast to emergency preparedness measures, the social benefits, in terms of employment, balanced regional growth and increased security of supply, outweight the costs. In the case of the Alberta oil sands, recent analyses show the supply costs for new developments are less than those indicated by federal documents released during the past year. Alberta proposes a committed and agressive policy on the part of governments to get these projects going. 4 refs., 1 fig.

40059 (PMA—22041981) **Method for measurement of Canadian ownership and determination of control under the National Energy Program.** (Petroleum Monitoring Agency, Ottawa, Ontario (Canada)). 22 Apr 1981. 88p. (CE—01679). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

This document is a reflection of Canadian federal policy with regard to the measurement of Canadian ownership of energy resources and determination of Canadian control. Such measurement and determination is a requirement for certain policy initiatives in the National Energy Program, whose objectives include assuring security of Canadian energy supplies, offering Canadians opportunity to participate in energy industries, and providing a pricing and revenue sharing regime which is fair to all Canadians. The first part of this document presents a brief outline of the principles and concepts that underlie the measurement of Canadian ownership and determination of Canadian control in the oil and gas industry. The second part presents detailed guidelines on the calculation of the Canadian ownership rate, determination of Canadian control, issuance of certificates of Canadian ownership and control, and documentation required under these procedures. Separate schedules are included relating to such matters as equity, determination of market value, share ownership, and determination of arm's length relationships. 2 figs., 1 tab.

2950 Hydrogen And Synthetic Fuels

REFER ALSO TO CITATION(S) 39467

40060 (UCID—20622-88-1) **Weapons-supporting research and departmental institutional research and development, First half FY88: Chemistry and materials science research report.** (Lawrence Livermore National Lab., CA (USA)). 31 May 1988. Contract W-7405-ENG-48. 105p. NTIS, PC A06/MF A01;1; GPO Dep. Order Number DE88012444/JAW.

Basic and applied research in the Chemistry and Materials Science Department is carried out under the auspices of Weapons-Supporting Research (referred to as Chemistry Research Resource,

or CRR)and the departmental Institutional Research and Development program. These activities tend to have longer-term goals than those funded directly by Laboratory programs. The report is divided into three sections describing activities in seven areas, the individual CRR projects, and the departmental IR&D projects. Areas are: high-temperature superconductors; tritium; high explosives; advanced characterization; interfaces, adhesion and bonding; advanced synthesis and processing; plutonium and actinides.

40061 **Synfuels development in the USA: Case studies of national environmental feasibility and local socioeconomic impacts.** Williams, T. (US Dept. of Energy, Washington, DC (US)). pp 77-99 of Large scale energy projects: Assessment of regional consequences. Lakshmanan, T.R.; Johansson, B. New York, NY; Elsevier Science Pub. Co. Inc. (1985).

This paper describes an assessment of the regional, environmental, resource, and socioeconomic impacts of a US national policy to accelerate the exploitation of synthetic fuels - liquids and gas from coal and gas shale. The policy was first proposed by President Carter in July 1979, at which time phase I of this regional assessment was completed to support the assertion that it would be feasible to develop an industry that could produce over 1 million barrels of crude oil equivalent per day (b.p.d.) without severe environmental consequences. The policy was implemented about a year later by the US Congress in the form of the Energy Security Act (1980), about six months after the final draft of the more complete assessment described here was made available for public review. The Act called for the setting up of the US Synthetic Fuels Corporation (SFC) with funds of up to $88 billion for the rapid commercialization of synfuels technology. The SFC continues, but has not accelerated synfuels development at levels anticipated by the Carter Administration. This is because of a number of factors, including slow economic growth, inflation, and high interest rates in the early 1980s, and the present low cost of naturally light crude oil. However, for a variety of reasons, it appears that both the policy and the supporting assessment have facilitated synfuels development in the US. The assessment prepared by the Department of Energy (DOE 1979b) centered on a regional analysis of environmental impacts on an unprecedented scale.

2960 Electric Power

REFER ALSO TO CITATION(S) 39473, 39614, 39616, 40041, 40079, 41325, 41326, 41327, 41328

40062 **(AL/GSS—29081986) Electrical accidents in Alberta, April 4, 1985 to March 31, 1986.** (Alberta Labour, Edmonton (Canada). General Safety Div.). 29 Aug 1986. vp. (MICROLOG—88-01996). Alberta Labour, 10808-99 Ave., Edmonton, Alta., Canada T5K 0G3; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

This report contains a summary of electrical accidents in Alberta investigated by the Electrical Protection Branch of Alberta and those investigated and reported to the Branch by Municipal Inspection Authorities from Calgary, Edmonton and Lethbridge. The report also includes a summary of power line contacts reported to the Electrical Protection Branch. Any underground power line contacts listed involve high voltage cables or equipment only. Investigations were conducted when fatalities or injuries occurred and in other instances when warranted. Accidents are chronologically listed in order of their occurrence and include only those where fatalities or injuries resulted.

40063 **(BCH/RC—IR841) [B.C. Hydro] Electric load forecast, 1987/1988-2007/2008. Low-probable-high.** (British Columbia Hydro, Vancouver (Canada). Residential and Commercial Energy Management). 1987. 50p. (MICROLOG—88-02442). Residential and Commercial Energy Management, B.C. Hydro, 3 - 1265 Howe Street, Vancouver, B.C., Canada V6Z 2C8; $N/C.

The British Columbia economy is forecast to average 2.9% real annual growth over the period to 1997 and 2.8% in the following 10-year period to 2007. The main growth areas through 1997 are projected to be paper and allied manufacturing, non-resource based manufacturing, construction, and community, business and personal services. Population growth in the 1.3% to 1.4% range on an annual average basis is expected through the 20-year period. Electricity prices are assumed to be held flat in nominal terms through 1994, and increase at the rate of inflation thereafter. Assuming an inflation rate of 4.5% this equates to a further reduction in real electricity prices of nearly 15% compared to last year's forecast. Electric energy requirements, in the probable case, are projected to increase from 38,306 GWh in 1986/87 to 51,510 GWh in 1997/98 and to 68,260 GWh in 2007/08 for an annual average growth rate of 2.8%. This report details the projections by forecast sectors, and shows historical and projected gross requirements and growth rates. Growth in sales to 1997/98 is projected at a net 11,300 GWh. Growth by major sector shows residential with 2,850 GWh, commercial with 3,700 GWh and industrial with a net of 4,600 GWh. Within the industrial area the paper and allied products sector is projected to grow by 3,150 GWh but the metal mining sector to decrease by 1,000 GWh with closures of existing copper mines. This year's sales forecast is marginally higher for 1997/98 than last year's. The significant changes are a major increase in sales to the paper and allied products sector (2,100 GWh) and a significant decrease in sales to the metal mining sector (1,000 GWh). 9 figs., 19 tabs.

40064 **(CEENB—29061987) The Electric Energy Commission of New Brunswick annual report, 1986/1987.** (Commission d'Energie Electrique du Nouveau-Brunswick, Fredricton (Canada)). 29 Jun 1987. 34p. (In French). (MICROLOG—88-02419). New Brunswick Electric Power Commission, 515 King St., Fredericton, N.B., Canada E3B 4X1; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

This report covers the year's activities of the Commission responsible for generation and distribution of electrical energy in New Brunswick. Data are presented on sales of electric power within the province and for export, the competing energy sources and their importance in the total energy supply, peak demand, and electric energy prices. Interconnections with other power systems are described, new construction and acquisition of new supply sources, such as the purchase of NB Coal Limited in 1986, are outlined. Brief mention is also made of research, conservation and introduction of new technologies. Financial statements are included.

40065 **(CONF-8804151—1) Key issues for state regulators on electric-utility integrated resource planning.** Hirst, E. (Oak Ridge National Lab., TN (USA)). 1988. Contract AC05-84OR21400. 17p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88011380/JAW.

From NARUC conference on least cost utility planning; Aspen, CO, USA (11 Apr 1988).

State Public Utility Commissions face several important issues concerning long-term resource planning for the electric utilities they regulate. These issues include adoption of a prospective, rather than retrospective, view of utility actions; a concomitant consideration of protection from prudency reviews; development of a cooperative and open planning process that involves the utility, its customers and regulators; and explicit treatment of uncertainty in resource planning and resource acquisition. This paper briefly defines integrated resource planning and suggests new roles and responsibilities for commissions. The paper then focuses on appropriate treatment of risk and uncertainty in utility planning and decision making. Uncertainty is a critical element that strongly affects resource planning and implies substantial changes in the obligations of state regulatory commissions. The paper concludes that improved planning procedures can provide substantial benefits to customers, utilities, and regulators. 6 refs., 3 figs., 4 tabs.

40066 **(DOE/EA—0287) Proposed power rate adjustment: Collbran Project: Environmental assessment.** (USDOE Western Area Power Administration, Washington, DC). Jan 1986. 17p. NTIS, PC A03/MF A01; GPO Dep. Order Number DE88008271/JAW.

The Western Area Power Administration (Western) proposes to increase the rate charged for electricity generated by the Collbran Project. Public notification of this intent was published in the Federal Register on October 22, 1985. The Collbran Project

presently serves only one customer, Colorado-Ute Electric Association (Colorado-Ute). Colorado-Ute currently purchases all the energy from Collbran, about 53,937,000 kWh per year. In compliance with the National Environmental Policy Act of 1969 (NEPA) and the Council on Environmental Quality (CEQ) Regulations for Implementing NEPA (November 1978), Western prepared this environmental assessment (EA) to analyze the potential environmental and socioeconomic impacts of the proposed rate adjustment and alternatives to the proposed action. Consideration was also given to the aspects listed below in accordance with the DOE guidelines on the preparation of environmental reviews for proposed PMA rate adjustments: 1) the percentage of total requirements supplied by the PMA; 2) the relative prices between PMA supplied power and other sources; 3) the level of induced fuel switching, if any; and 4) impact to the ultimate consumer (end user).

40067 **(DOE/EA—0292) Roseville Direct Service 230 kV Transmission Line Project, Sacramento and Placer Counties, California: Environmental assessment.** (USDOE Western Area Power Administration, Washington, DC). Jun 1986. 69p. NTIS, PC A04/MF A01;1; GPO Dep. Order Number DE88008272/JAW.

At present, the only transmission line serving the City of Roseville is operated by Pacific Gas and Electric Company (PG and E), which serves the City's Berry Street substation with a 60-kV circuit from the company's own Atlantic Street substation. Western pays wheeling charges to PG and E for use of their lines to deliver power to its customers which cannot be served directly. PG and E has informed Roseville that additional system facilities are required to meet the City's firm transmission requirements in excess of 69 megawatt peak. They proposed to build a new 230-kV line and transformer bank at a cost of $10.9 million which the City would have to pay, in addition to the wheeling charges Western would be charged to use the PG and E line. The City's preferred alternative is to have Western construct a direct 239-kV service from its Elverta substation to the Berry Street substation. This would save the city money in construction capital cost, result in more transmission capacity and eliminate the present wheeling costs charged to Western. Mitigation recommendations are included.

40068 **(DOE/EA—0294) Rio Grande Project: Proposed rate adjustment: Environmental assessment.** (USDOE Western Area Power Administration, Washington, DC). 22 Aug 1986. 14p. NTIS, PC A03/MF A01; GPO Dep. Order Number DE88008273/JAW.

This environmental assessment (EA) analyses the potential environmental and socioeconomic impacts of the proposed rate adjustment and alternatives to the proposed action where the proposed adjustment is greater than the estimateed inflation rate. Consideration was also given to the following aspects listed below in accordance with the DOE guidelines on the preparation of environmental reviews for proposed PMA rate adjustments: size of the wholesale rate increase, percentage of total customer requirement supplied by the RGP, price of RGP power compared to the price of alternate power, level of potential fuel switching by RGP customers and impact to the ultimate consumer (end user).

40069 **(EMR—071987) Ontario's future electricity demand.** (Department of Energy, Mines and Resources, Ottawa, Ontario (Canada)). Jul 1987. 39p. (MICROLOG—88-01772). Ontario Hydro Research Division, Editorial Section, 800 Kipling Ave., Toronto, Ont., Canada M8Z 5S4; $10.00 CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

Ontario's need for electricity is expected to grow steadily through to the end of the century, but more slowly than the economy. This represents a sharp break from trends established in earlier decades. Three factors account for the slower growth that is foreseen for electricity demand. First, the service sector may account for two-thirds of the growth in the economy between now and the year 2000. This sector uses only half as much electricity per dollar of output as the industrial sector. Second, energy-efficient technologies are being increasingly adopted throughout the economy - in space heating, in industrial processes, and in the operation of household appliances. This will be a major restraining force in the demand for all forms of energy including electricity. Third, the fall in oil and natural gas prices since 1985 has made electricity less competitive and the effect will be slower expansion of electricity markets. Despite this relatively slow growth, the province will use about 40% more electrity bypy the turn of the century. Different scenarios could produce a range of demand growth paths. For example, with strong electricity conservation actions by government and utilities, growth could be as low as 1.4% a year. Conversely if the economy became more electricity intensive over this period electricity growth could reach 3.4% annually. For a range of energy price and economic outlooks, electricity demand growth could average between 2.0 and 2.7 per cent per annum to the turn of the century. In the next few years a relatively buoyant economy could push the growth rates above the long-term average. 34 figs., 20 tabs.

40070 **(EPRI-EL—5807-SR) Transformer overload and bubble evolution: Proceedings.** Addis, G.; Lindgren, S. (eds.). (Electric Power Research Inst., Palo Alto, CA (USA)). Jun 1988. 173p. (CONF-871290—). Unlimited audience, publicly available. Research Reports Center, Box 50490, Palo Alto, CA 94303;3. Order Number TI88011930/JAW.

From Transformer overload and bubble evolution; Palo Alto, CA, USA (8 Dec 1987).

The EPRI workshop on Transformer Overload Characteristics and Bubble Evolution was held to review the findings of investigations over the past 7-8 years to determine whether enough information is now available for utilities to establish safe loading practices. Sixteen papers were presented, including a utility review, physical and dielectric effects of gas and bubble formation from cellulose insulated transformers, transformer life characteristics, gas bubble studies and impulse test on distribution transformers, mathematical modeling of bubble evolution, transformer overload characteristics, variation of PD-strength for oil-paper insulation, survey on maximum safe operating hot spot temperature, and overload management. The meeting concluded with a general discussion covering the existing state of knowledge and the need for additional research. Sixteen papers have been cataloged separately.

40071 **(EPRI-EL—5859) Technical limits to transmission system operation: Final report.** Barthold, L.O. (Electric Power Research Inst., Palo Alto, CA (USA); Power Technologies, Inc., Schenectady, NY (USA)). Jun 1988. 218p. Unlimited audience, publicly available. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88012775/JAW.

A study was undertaken to gather, organize and publish the techniques used by engineers in the US and overseas to increase transmission capabilities where new lines cannot be built. Literature searchers, surveys, workshops, and personal contacts were used to collect and consolidate the information. Among the entities contacted were utilities, equipment suppliers, engineering organizations, power pools and reliability councils in the US and abroad. The report provides an organized comprehensive source book of practical techniques used to increase transmission capability. This includes not only techniques currently in use, but also those proposed and those in the research stage. Over 160 citations of publications on increasing transmission capacity are contained in the reference section. 168 refs., 43 figs, 8 tabs.

40072 **(EPRI-EM—5703-Vol.2) Commercial end-use data development handbook: COMMEND market profiles and parameters: Volume 2, COMMEND data and parameter developemnt techniques: Interim report.** McMenamin, J.S. (Electric Power Research Inst., Palo Alto, CA (USA); Regional Economic Research, San Diego, CA (USA)). Apr 1988. 249p. Unlimited audience, publicly available. Research Reports Center, Box 50490, Palo Alto, CA 94303;1. Order Number TI88011696/JAW.

COMMEND, the EPRI commercial-sector end-use planning system, has been distributed to about 100 utilities for forecasting and market planning. The program is distributed with ten regional data bases and a variety of supporting documentation. Although the regional data sets are often used as a starting point, most utilities decide to customize the input data to reflect their own market research results and the particular economic circumstances of their

own service territory. As a result of these efforts, experience in commercial market research and model use has increased dramatically. New data development approaches have been attempted, and refinements in analysis techniques have been implemented. This handbook expands and updates the COMMEND documentation to incorporate the new approaches and methods. It provides a detailed guide for end-use data development in the commercial sector. Volume 1 provides a review of the COMMEND framework for organizing and anlayzing market data and for forecasting future energy-use patterns. The framework is illustrated with representative results. Volume 2 provides detailed discussions of analysis concepts, data sources, and data development techniques. 13 refs., 47 figs., 24 tabs.

40073 **(EPRI-EM—5806-Vol.1) Secondary data for demand-side management planning and implementation: Volume 1, Guidebook: Final report.** Limaye, D.R.; Burkey, M.B.; Davis, T.D. (Electric Power Research Inst., Palo Alto, CA (USA); Synergic Resources Corp., Bala-Cynwyd, PA (USA)). May 1988. 151p. Research Reports Center, Box 50490, Palo Alto, CA 94303;1. Order Number TI88011363/JAW.

Report includes 1 diskette.

Information on market characteristics is needed for effective planning and implementation of demand-side management (DSM) programs. A wide range of information can be obtained quickly and inexpensively from existing data sources. This report identifies the sources of secondary data, including federal, state and local government agencies, utilities, EPRI and various private organizations. The specific types of data available from these organizations and their applicability and usefulness in demand-side management, are reviewed. A PC-based software package, DATA-DSM, has been developed to assist the user in easily and quickly identifying the relevant secondary data sources. The Guidebook is organized in two volumes. The first volume provides a comprehensive listing of the data sources and software to assist market implementation planning, and provides a description and user guide for the DATA-DSM software package. The second volume provides the results for three illustrative utility case studies, and presents an illustrative example of the use of geographic mapping software to display secondary data. 14 figs., 32 tabs.

40074 **(HQ—1987) The costs of electricity supply.** (Hydro-Quebec, Montreal (Canada)). [1987]. 27p. (In French). (MICROLOG—88-02411). Hydro-Quebec, Centre de diffusion, 75, boul. Dorchester ouest, 14e etage, Montreal, P.Q., Canada H2Z 1A4; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

This document intends to explain what the costs of electricity supply in Quebec are and how they are evaluated in order to establish rates and to analyze the profitability of new markets. Over the next few years, the supply costs calculated by the cost-price accounting approach will serve as a guide to determine prices. As for the concept of cost as used to analyze market profitability, this is based on the economic costs which are the most applicable. In order to obtain a significant orientation and to detach oneself from short term anomalies (for example, a situation of surplus), it is necessary in the framework of a rate policy to project on a short term horizon the evolution of supply costs and, from that, the presumed evolution of rates. The year 1993 has been chosen as horizon, which implies that the supply costs calculated according to cost price accounting will reflect the costs associated with present equipment as well as those which will be put into operation from here on until that time. A comparison is made of rates calculated according to the two approaches, and it shows that the average cost is higher for the economic cost method, although the "lighting and other" rate category shows a slight advantage to the economic cost method. 12 figs., 7 tabs.

40075 **(HQ—021987) [Hydro-Quebec] Proposed tariffs for 1987.** (Hydro-Quebec, Montreal (Canada)). Feb 1987. 36p. (In French). (MICROLOG—88-02412). Hydro-Quebec, Centre de diffusion, 75, boul. Dorchester ouest, 14e etage, Montreal, P.Q., Canada H2Z 1A4; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

This report shows the evolution of the price of electricity in Quebec and gives a proposed rate structure for Hydro-Quebec taking into account the objectives of that electric utility. A main objective is to assure that rates be advantageous and stable to its Quebec customers over short and long term. This objective rests in a large part on the correct financial situation of the utility. The objective of seeking and maintaining such rates rests on different strategies which combine to limit cost increases in electricity supply. The rate strategies over the next few years will contribute to assure these objectives while respecting the directing principles of the rate policy previously announced, namely: to maintain regional price uniformity and to treat customers who exhibit similar consumption characteristics in the same fashion; to reflect as much as possible and as gradually as possible the costs of supply associated with the various products delivered to the different rate categories; to facilitate understanding and application of the rate structure; and to take into consideration the customers' modes of operation. A number of rate structures are explored and compared, relevant to domestic, commercial and industrial use at various levels of consumption, and rate structure tables for the proposed rate structure are given. 5 figs., 13 tabs.

40076 **(HQ—021987) [Hydro-Quebec] Financial results for 1986. Preliminary report.** (Hydro-Quebec, Montreal (Canada)). Feb 1987. 29p. (In English and French). (MICROLOG—88-02482). Hydro-Quebec, Centre de diffusion, 75, boul. Dorchester ouest, 14e etage, Montreal, P.Q., Canada H2Z 1A4; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

This report describes the financial performance of Hydro-Quebec during 1986. Discussion is made of the factors that influence revenue such as the cost of competing energy sources, exchange rates, and interest rates. Comparisons with forecasted performance are made. Financing, debt structure and investments are outlined. Financial statements and balance sheets are included. 6 tabs.

40077 **(ME—3460M) The Coordinating Committee of Maritime Electric Utilities annual report, 1986.** (Maritime Electric Co. Ltd., Charlottetown, Prince Edward Island (Canada); New Brunswick Power, Fredericton (Canada); Nova Scotia Power Corp., Halifax (Canada)). 1986. 79p. (In French). (MICROLOG—88-01976). Coordinating Committee of Maritime Electric Utilities, Council of Maritime Premiers, 5161 George St., Ste. 1006, PO Box 2044, Halifax, N.S., Canada B3J 2Z1; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

The Committee submitting this report has the intended responsibility of ensuring a cooperative effort among the electric utilities of New Brunswick, Nova Scotia and Prince Edward Island in the development and operation of an economic and efficient interconnected regional power system. Specific responsibilities include developing coordinated load forecasts and utility expansion plans, identification and evaluation of regional electric utility development opportunities, coordination of operations to achieve improved security of supply and minimized regional generating costs, coordination of electric energy research and development, conservation and related regional activities, providing a regional focus for operations coordination with neighboring utility systems, and other matters that may be directed by Council of Maritime Premiers. This report covers the year's activities of the Committee and includes subcommittee reports on regional operations, regional planning and research and development programs. Detailed research project outlines are included. Data presented include load forecasts and generating capacites.

2980 Consumption And Utilization

REFER ALSO TO CITATION(S) 40043, 40083, 40085

40078 (BCU—031983) Energy and the elderly: facts and observations. Literature review and analysis of CCA data. Gorn, G.J. (British Columbia Univ., Vancouver (Canada)). Mar 1983. 98p. (CE—01421). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

Both a literature review and the analysis of 1978 and 1980 Canadian data provide similar profiles of the elderly. In general, the elderly use less energy because they tend to have fewer people in the household, live in smaller dwellings and own fewer energy consuming appliances. Their homes however are older and therefore less fuel efficient. The lower consumption by the elderly reflects the lower consumption by low income people in general. Although the elderly use less energy, they spend a higher proportion of their income on energy-related expenditures. They may therefore be particularly vulnerable to increasing energy costs. To save money, the elderly say they have already cut back on the use of energy consuming appliances. The elderly consume less car-related energy. They own fewer vehicles and drive less. However, like their homes, their cars are older and therefore less fuel efficient. Whether the elderly continue to work full-time after age 65 affects energy consumption. Energy consumption is greater and more similar to the consumption of younger people for those elderly who continue to work. Nevertheless, after controlling for work status, energy consumption still decreases with age. It should be noted that this report mainly considers the elderly of today; the elderly of tomorrow will probably be different. They are analyzed in the closing section of this paper. 34 refs., 6 figs., 32 tabs.

40079 (DOE/EIA—0469(87)) Energy facts, 1987. (USDOE Energy Information Administration, Washington, DC). 15 Jun 1988. 55p. NTIS, PC A04 - GPO. Order Number DE88012506/JAW.

1987 was the year of partial recovery for most segments of the US energy industry. Gains were reported in energy revenue and income compared to the depressed levels that followed the 1986 plunge in crude oil prices. Higher 1987 crude oil prices resulted in increases in the average prices of most petroleum products during the year. In contrast, prices of natural gas and coal declined. This fourth edition provides a reference to a broad range of domestic and international energy data for the general public as well as the technical community. It is designed especially for the business person, government worker, or student who needs a quick reference to major facts about energy. The data cover 1975 through 1987, except for international energy data, which cover 1976 through 1986. Graphs, charts, and illustrations portray trends, shares, and locations of various energy sources and users.

40080 (LBL—22788) Dynamics of change in oil and energy use in four Latin American countries. Ghirardi, A. (Lawrence Berkeley Lab., CA (USA)). Dec 1986. Contract AC03-76SF00098. 31p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88008423/JAW.

This report describes changes in energy demand in the 1970--1984 period and the causes for those changes for the four largest Latin-America countries: Argentina, Brazil, Mexico, and Venezula. Together these countries account for around three-fourths of total energy use in Latin America. Latin American energy use accounts for over 10 percent of the world's total, 40 percent of the LDC total, and has grown at an average yearly rate of 4.8 percent since 1973. The analysis is based on energy and economic data prepared for the Developing Country Data Series developed by the International Energy Studies Group of Lawrence Berkeley Laboratory (IES-LBL). Data were obtained from local sources during visits to government offices, academic research institutions, and from the private sector. We first discuss aggregate trends in energy demand in the 1970--1984 period. We then look separately at the four major sectors: industry, transportation, residential/commerical, and power generation. In these sections we focus on change in energy and oil intensity and the structural causes for those changes. 6 refs., 3 figs., 18 tabs.

2990 Unconventional Sources And Power Generation

REFER ALSO TO CITATION(S) 39466, 39532, 39541, 39592, 40127, 40219

40081 (NP—8770047) Reports by biomass energy subcommittee. Yada, Naoki; Najima, Tatsuo; Tsuda, Masuo; Kobayashi, Kenjiro; Hisazuka, Ken'ichi; Yokoyama, Nobuya; Takagi, Motofuku. (Japan Petroleum Inst., Tokyo). Oct 1984. 70p. (In Japanese). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88770047/JAW.

These are summaries of reports for the past one year and a half on the technology, development, related materials, etc. on biomass conversion. Biomass application for energy, resources, development status of conversion process, biochemical conversion, thermochemical conversion process, and usage of converted products of biomass are reported. In the field of conversion process, development of conversion system by microbe has been very active. Wood liquefaction and gasification may have wide application as resources and chemical raw materials in the thermochemical conversion area. In the area of application of biomass converted products, the tendency is the use of liquefied fuel to substitute petroleum and the production of chemical products. One of the strong points of biomass is its nature of being reproducible. On the other hand, it is thinly distributed. The continuous ethanol production system developed in Japan is very effective and is attracting worldwide attention. Thermal decomposition, gasification, and liquefaction of wood are the main fields of thermochemical conversion. (22 figs, 30 tabs, 153 refs)

40082 (NRC/E—17978) Renewable energy research and development in Canada. Chappell, M.S. (National Research Council of Canada, Ottawa, Ontario. Div. of Energy). Dec 1979. 49p. (CE—01502). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

Canadian research and development (R & D) in renewable energy began as a result of the oil crisis in 1974, and in keeping with government policy, is predominantly carried out in the private sector under contract to the federal government. The variety in technical maturity of the renewable energy technologies is reflected in the non-uniform funding levels among the five constituent programs. The greatest support is allotted to solar energy in recognition of its enormous potential, both in low to mid-temperature thermal and in photovoltaic applications. This report describes the technical content of these five renewable energy and R & D programs, and outlines the organization and management structures used to direct the effort. Biomass energy R & D concentrates on the harvesting, processing and conversion of wood wastes into convenient fuel forms. Near-term applications will continue to be in the forest products industries. Wind energy R & D in geothermal energy are focussed on identification and quantification of the resource. A five-megawatt experimental geothermal heating system is being established at the University of Regina. The hydraulic energy R & D program does not consider conventional hydro-electric systems which are well developed; rather, it primarily covers laboratory-scale tests on conversion devices for wave, tidal, and river flow energy systems. A substantial effort is also underway in analytic and modelling techniques for hydraulic energy systems of all types. 3 figs., 2 tabs.

40083 (RV—061987) Survey of wood fuel use in Prince Edward Island, 1986-1987. Bennie, S.H. (Resource Ventures, Inc., Charlottetown, Prince Edward Island (Canada)). Jun 1987. 33p. (MICROLOG—88-01514). Prince Edward Island Dept. of Energy and Forestry, P O Box 2000, 105 Rochford Street, Charlottetown, P.E.I., Canada C1A 7N8; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

In May 1987 a survey of 410 households was conducted in Prince Edward Island. This survey represented a 1% sample of the 41,000 households in the province. The survey indicated that the average wood burning household consumes 5.6 cords of wood per year, an increase of just under 8% from the last survey in 1984-1985. During this period the proportion of hardwood increased

from 71.5% to 75%. While just over 68% of the wood is burned by those who cut their own wood, the wood buyers burn a high (83%) percentage of hardwood and are much more likely to switch back to oil if hardwood shortages develop. It is estimated that 23,180 households (55%) in the province burn 129,000 cords of fuelwood. The volume of fuelwood will displace 58.6 million litres of light fuel oil for a value of $19 million in displaced oil purchases. 30 tabs.

40084 **(VB—091982) Economic impacts of expenditures on solar heating. Final report.** (Victor and Burrell (Canada)). Sep 1982. 91p. (CE—01664). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

This study examines a range of macroeconomic impacts of expenditures on residential active (domestic hot water) and passive solar heating systems in Canada. The impacts considered are employment, gross domestic product, gross production and federal tax revenues. For purposes of comparison, the impacts of expenditures on electric power generated at existing facilities, and the construction of new nuclear and coal-fired generating stations are also estimated. Representative designs of a new and retrofitted passive solar house, and a typical solar water heating system, were developed and costs were estimated and incorporated into an interprovincial input-output model from Statistics Canada. The model provides estimates, at provincial level, of economic impacts associated with any specified set of expenditures. One of the two sets of estimates made for employment and gross domestic product takes into account the impacts from consumer purchases out of household incomes earned from solar heating or alternate expenditures. Variations among the provinces are considerable, but the overall pattern that emerges from the results is as follows. Expenditures on solar heating generate more employment, gross domestic product and federal revenues than equal expenditures on electric power and additional generating capacity. The province in which the expenditures are made and the systems are installed receives most of the immediate impacts. Subsequent impacts are generally channeled to Ontario and Quebec. Impacts from expenditures on electric power are more localized than for any other option. 8 refs., 2 figs., 33 tabs.

40085 **Residential wood use trends in the Pacific Northwest.** Tonn, B.; White, D.L. (Oak Ridge National Lab., Oak Ridge, TN (US)). *Energy Systems and Policy;* **11**: No. 3, 231-250(1987).

This article analyzes wood used for residential space heating in the Pacific Northwest between 1979 and 1985. Issues addressed are the levels and trends of wood use, as well as relationships of wood use to conservation program planning and evaluation. Six data sets were used in the analysis: three contain data on representative samples of housing units in the Bonneville Power Administration's service area; and the other three are products of Oak Ridge National Laboratory evaluations of Bonneville's residential conservation programs' energy savings. Some of the more important findings are: wood used as the primary space heating fuel increased from 10% of all households in 1979 to greater than 20% in 1983; ownership of wood stoves as wood heating systems increased from 30% of wood burning systems in 1979 to 60% in 1983; wood increased its market share as the primary space heating fuel in new single-family homes, rising from 12% in 1979 to 25% in 1983; and the equipment needed to use wood as a source of heat was present in 48% of the housing units in 1983. Due to its increased importance, Pacific Northwest power suppliers must incorporate wood use into demand forecasting and conservation programs planning activities.

30 DIRECT ENERGY CONVERSION

3001 Mhd Generators

REFER ALSO TO CITATION(S) 41738

40086 **(CONF-880702—7) System analysis of high performance MHD systems.** Chang, S.L.; Berry, G.F.; Hu, N. (Argonne National Lab., IL (USA)). 1988. Contract W-31109-ENG-38. 5p. NTIS, PC A02/MF A01;1; GPO Dep. Order Number DE88009994/JAW.

From 23. intersociety energy conversion engineering conference; Denver, CO, USA (31 Jul 1988).

This paper presents the results of an investigation on the upper ranges of performance that an MHD power plant using advanced technology assumptions might achieve and a parametric study on the key variables affecting this high performance. To simulate a high performance MHD power plant and conduct a parametric study, the Systems Analysis Language Translator (SALT) code developed at Argonne National Laboratory was used. The parametric study results indicate that the overall efficiency of an MHD power plant can be further increased subject to the improvement of some key variables such as, the MHD generator inverter efficiency, channel electrical loading factor, magnetic field strength, preheated air temperature, and combustor heat loss. In an optimization calculation, the simulated high performance MHD power plant using advanced technology assumptions can attain an ultra high overall efficiency, exceeding 62%. 12 refs., 5 figs., 4 tabs.

40087 **(IEACR—06) Coal-fired MHD [magnetohydrodynamics].** Morrison, G.F. (IEA Coal Research, London (UK)). Apr 1988. 32p. NTIS (US Sales Only), PC A03. Order Number TI88013153/JAW.

This report reviews the status and prospects of coal-fired magnetohydrodynamics (MHD). A brief description of the MHD process and its claimed advantages is followed by a review of national research programmers. The development status of the individual components which make up a MHD system is presented prior to an assessment of the economics. It is concluded that whilst no insurmountable technical problems have been identified in the development of MHD there remains much development work, particularly on materials. The feasibility of generating electricity from early commercial plants at efficiencies of about 40% and with low emissions has been demonstrated. However, the economics of such processes are not favourable when compared with other advanced coal-based generating systems. Whilst advanced MHD systems promise efficiencies and economics they are based on as yet unproven heat exchanger technology. 69 refs., 15 figs., 1 tab.

40088 **(WAESD-TR—88-0013) Conceptual design of a coal-fired MHD retrofit plant: Quarterly report, January 1988--March 1988.** Van Bibber, L.E.; Pierre, J.F. (Westinghouse Electric Corp., Pittsburgh, PA (USA). Advanced Energy Systems Div.). Jun 1988. Contract AC22-87PC79668. 29p. NTIS, PC A03;3. Order Number DE88011926/JAW.

The objective of the systems analysis task is to define an optimized set of operating conditions for the Scholz MHD Retrofit Plant. These operating conditions must satisfy the prescribed system requirements and be consistent with the overall objectives of this conceptual design study: to demonstrate the technical and economic viability of an MHD system operating within an electric utility environment. Thus, the Retrofit Plant must be both efficient and economically attractive. Parametrics studies resulted in an optimized components arrangement for the MHD System. Using this component arrangement, a series of sensitivity studies were completed. These studies evaluated twenty-five operating conditioning covering oxygen enrichment levels from 32 to 40% and combustion pressures between 4 and 8 atmospheres. The criteria used to identify the reference operating conditions are relative plant performance and relative cost-of-electricity (COE). Plant performance is defined as the thermal input to the plant divided by the net ac output. This accounts for all possible losses, including the dc to ac power inversion loss. To ensure that all twenty-five cases were evaluated on a

similar basis, the following operating paramaters were held constant: primary combustion of 0.88 stoichs; oxidant preheated to 1450{degree}F; secondary combustion at 1.05 stoichs; secondary air preheated to 600{degree}F; gas velocity exiting MHD generator at Mach 1.0; feedwater available at 1080 psia, 425{degree}F; required steam flow of 460,000 lb/hr at 875 psia, 908{degree}F; and combustion gas temperature at 400{degree}F exiting the bottoming cycle. The most efficient cases were found at intermediate combustion pressures of 6 and 7 atmospheres with intermediate oxygen enrichment levels at 36 to 38%. To determine the most attractive operating conditions based on economics, a cost-of-electricity was calculated for each of the twenty-five cases. 4 figs., 4 tabs.

3003 Thermoelectric Generators

40089 **(AD-A—191346/6/XAB) Preparation of improved PbSnTe thermoelectric alloys and evaluation of their figure of merit. Final technical report, 1986-1987.** Rowe, D.M. (University of Wales Inst. of Science and Technology, Cardiff (UK)). Dec 1987. 27p. NTIS, PC A03/MF A01.

Lead-telluride-type semiconductors are used in the fabrication of thermoelectric modules currently employed in a number of US military applications. This report covers a programme to produce materials based upon commercially available lead-telluride-type material (specifically identified as 3P) with improved figures of merit and hence greater thermoelectric-conversion efficiency. One way of improving the figure of merit is by reducing the lattice thermal conductivity of the material in order to increase phonon-grain boundary scattering. A realistic model was developed for PbSnTe and used to investigate the dependence of the lattice thermal conductivity on grain size and level doping. Thermal diffusivity measurements on small gain size compacted 3P material indicate that the reduction in lattice thermal conductivity is more than double that predicted by the theoretical model and is comparable to the reduction reported for silicon-germanium alloys. The measured electric power-factor values do not appear to decrease with a reduction in grain or size.

40090 **(AD-A—191347/4/XAB) Optimisation of the thermoelectric figure of merit of modified silicon-germanium alloys. Interim report No. 1.** Rowe, D.M. (University of Wales Inst. of Science and Technology, Cardiff (UK). Dept. of Physics, Electronics, and Electrical Engineering). Oct 1987. 3p. NTIS, PC A02/MF A01.

Alloys of silicon and geranium are established semiconductor materials for use in high-temperature thermoelectric-conversion systems. The conversion efficiency of a thermoelectric device depends, among other things, upon the material properties of the thermoelements through the so-called figure of merit Z = (Alpha squared) Sigma/Lambda where alpha is the Seebeck coefficient, Sigma the electrical conductivity, and Lambda the total thermal conductivity. It was predicted and demonstrated experimentally that the lattice thermal conductivity Lambda/sub L/ of semiconductor alloys can be substantially reduced through the use of very-small-grain size compacted material.

3004 Thermionic Converters

40091 **(PB—88-865639/XAB) Thermionic cathodes. January 1972-May 1988 (Citations from the International Aerospace Abstracts data base). Report for January 1972-May 1988.** (National Technical Information Service, Springfield, VA (USA)). Jun 1988. 119p. NTIS PC N01/MF N01.

Supersedes PB—86-852142; U.S. sales only.

This bibliography contains citations concerning the experimental and theoretical studies of thermionic-emission cathodes. Recent models of cathodes are described by types, principles of operation, applications, and electrode materials. Some attention is given to the service life and reliability of various cathode types. (This updated bibliography contains 276 citations, 142 of which are new entries to the previous edition.)

40092 **(PB—88-865647/XAB) Thermionic cathodes. May 1985-May 1988 (Citations from the INSPEC: Information Services for the Physics and Engineering Communities data base). Report for May 1985-May 1988.** (National Technical Information Service, Springfield, VA (USA)). Jun 1988. 81p. NTIS PC N01/MF N01.

Supersedes PB—87-856753.

This bibliography contains citations concerning the principles, designs, types, manufacturing techniques, and performance evaluations of thermionic cathodes. Several electrode materials are evaluated for thermionic-emission characteristics. Some attention is given to the life testing and reliability of various cathode types. (This updated bibliography contains 140 citations, 44 of which are new entries to the previous edition.)

3005 Fuel Cells

REFER ALSO TO CITATION(S) 39440, 40224, 40394, 40471

40093 **(AD-A—191356/5/XAB) Compact regenerable sulfur scrubber for phosphoric acid fuel cells. Final report, 30 September 1986-30 September 1987.** Giner, J.; Cropley, C.C. (Giner, Inc., Waltham, MA (USA)). 30 Nov 1987. 48p. (C—86-12). NTIS, PC A03/MF A01.

Technology for the direct desulfurization of unprocessed diesel fuel using regenerable copper-based mixed metal oxide sorbents was developed for incorporation in modular phosphoric acid fuel cell (PAFC) generators. Removal of greater 60% of the sulfur in diesel fuel was demonstrated, and sorbent sulfur loadings of approximately 1 wt% were attained. Preliminary studies indicated that the sorbents are regenerable, with up to 70% of the sorbed sulfur removed during regeneration. Incorporation of this technology into a PAFC power plant should reduce the weight of the sulfur removal unit by a minimum of 25%.

40094 **(CONF-850511—Absts.) 1985 fuel cell seminar: Program and abstracts.** (Courtesy Associates, Inc., Washington, DC (USA)). 1985. 308p. (CONF-850511—Absts.). NTIS, PC A14/MF A01;1; GPO Dep. Order Number DE88008297/JAW.

From Fuel cell seminar; Tucson, AZ, USA (19 May 1985).

Seventy-nine brief papers are arranged under the following session headings: on-site phosphoric acid fuel cell program, technology base efforts, electric utility phosphoric acid fuel cell program, solid oxide fuel technology, transportation applications, special applications, carbonate fuel cell technology, industrial applications, and plans for commercial development. The papers are processed separately for the data base.(DLC)

40095 **(CONF-861008—Absts.) 1986 fuel cell seminar: Program and abstracts.** (Courtesy Associates, Inc., Washington, DC (USA)). Oct 1986. 386p. NTIS, PC A17;3. Order Number DE88008298/JAW.

From Fuel cell seminar; Tucson, AZ, USA (26 Oct 1986).

Ninety nine brief papers are arranged under the following session headings: gas industry's 40 kw program, solid oxide fuel cell technology, phosphoric acid fuel cell technology, molten carbonate fuel cell technology, phosphoric acid fuel cell systems, power plants technology, fuel cell power plant designs, unconventional fuels, fuel cell application and economic assessments, and plans for commerical development. The papers are processed separately for the data base. (DLC)

40096 **(CONF-880122—13) Monolithic fuel cell based power source for burst power generation.** Fee, D.C.; Blackburn, P.E.; Busch, D.E.; Dees, D.W.; Dusek, J.; Easler, T.E.; Ellingson, W.A.; Flandermeyer, B.K.; Fousek, R.J.; Heiberger, J.J.; Majumdar, S.; McPheeters, C.C.; Mrazek, F.C.; Picciolo, J.J.; Singh, J.P.; Poeppel, R.B. (Argonne National Lab., IL (USA)). 1988. Contract W-31-109-ENG-38. 5p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE88010044/JAW.

From 5. symposium on space nuclear power systems; Albuquerque, NM, USA (11 Jan 1988).

A unique fuel cell coupled with a low power nuclear reactor presents an attractive approach for SDI burst power requirements. The requisite high power, long-duration bursts appear achievable with appropriate development of the concept. A monolithic fuel cell/nuclear reactor system clearly possesses several advantages. Fabrication methods, performance advantages, and applications are discussed in this report.

40097 **(PB—88-203195/XAB) In situ spectroscopic studies of transition-metal macrocycles as catalysts for the electrochemical reduction of oxygen. Annual report, December 1986-November 1987.** Scherson, D.A.; Yeager, E.B. (Case Western Reserve Univ., Cleveland, OH (USA). Dept. of Chemical Engineering). Apr 1988. 35p. NTIS, PC A03/MF A01.

The vibrational, electronic, and structural properties of transition-metal macrocycles adsorbed on electrode surfaces are being investigated with an array of in situ spectroscopic techniques. These include potential difference FTIR, electrochemically modulated infrared spectroscopy, EMIRS, electromodulated reflection absorption spectroscopy in the UV-vis spectral region, Moessbauer spectroscopy in the transmission, and conversion-electron modes and x-ray absorption fine structure. The information arising from the use of these techniques is being complemented by conventional electrochemical measurements, and scanning tunneling microscopy as a means of imaging transition-metal macrocycles adsorbed on metal surfaces including infrared, ultraviolet-visible. Moessbauer and x-ray absorption fine structure. These studies are aimed at gaining a basic understanding of the factors that control the electrocatalytic activity of transition metal macrocycles adsorbed on electrode surfaces for the electrochemical reduction of dioxygen.

3008 Miscellaneous Converters

40098 **(AD-A—189218/1/XAB) Advanced space propulsion study - antiproton and beamed-power propulsion. Final report, 1 May 1986-30 June 1987.** Forward, R.L. (Hughes Research Labs., Malibu, CA (USA)). Oct 1987. 215p. NTIS, PC A10/MF A01.

The contract objective was to monitor the research at the forefront of physics and engineering to discover new spacecraft-propulsion concepts. The major topics covered were antiproton-annihilation propulsion, laser thermal propulsion, laser-pushed lightsails, tether transportation systems, solar sails, and metallic hydrogen. Five papers were prepared and are included as appendices. They covered 1) pellet, microwave, and laser-beamed power systems for interstellar transport; 2) a design for a near-relativistic laser-pushed lightsail using near-term laser technology; 3) a survey of laser thermal propulsion, tether transportation systems, antiproton annihilation propulsion, exotic applications of solar sails, and laser-pushed interstellar lightsails; 4) the status of antiproton annihilation propulsion as of 1986, and 5) the prospects for obtaining antimatter ions heavier than antiprotons. Two additional appendices contain the first seven issues of the Mirror Matter Newsletter concerning the science and technology of antimatter, and an annotated bibliography of antiproton science and technology.

40099 **(AD-A—191999/2/XAB) Performance of a hydrogen-pulsed electrothermal thruster. Strategic Defense Initiative Organization innovative science and technology. SBIR. Phase 1. Final report, 12 January-12 July 1987.** Burton, R.L.; Goldstein, S.A.; Wang, S.Y. (GT-Devices, Inc., Alexandria, VA (USA)). 28 Sep 1987. 47p. NTIS, PC A03/MF A01.

This report describes effort to determine the technical feasibility of measuring the performance of a pulsed electrothermal thruster on liquid hydrogen propellant. The design of a 5-kW thruster is presented, including the capacitive pulse-forming network, arc-discharge characteristics, nozzle performance, and predicted specific impulse and thrust. A thermal model is discussed which treats and solves the problem of liquid hydrogen. It is concluded that a Phase II test should concentrate on water and/or hydrazine, and liquid-hydrogen testing should be postponed to Phase III.

32 ENERGY CONSERVATION, CONSUMPTION, AND UTILIZATION

REFER ALSO TO CITATION(S) 40043, 40070

3201 Buildings

REFER ALSO TO CITATION(S) 39210, 39453, 39530, 39531, 39532, 39533, 39535, 40045, 40085, 40229, 41176, 41251, 41265, 41267, 41268, 41269

40100 **(AMA—091987) Demonstration and evaluation of recent air-sealing techniques in housing.** Mayhew, W.J. (Alberta Municipal Affairs, Edmonton (Canada). Innovative Housing Grants Program). Sep 1987. vp. (MICROLOG—88-02104). Alberta Municipal Affairs, Jarvis Bldg., 6th Floor, 9925-107 St., Edmonton, Alta., Canada T5K 2H9; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

The Airtight Drywall Approach (ADA) and the sealed polyethylene approach were developed as two distinct systems for reducing air leakage in housing. Builders have not totally accepted either method but have instead tended to borrow the most practical and cost-effective techniques and materials from each system and combined them into hybrid systems. This project evaluated current air-sealing techniques, developed refinements to some of those techniques and incorporated them into the construction of the Cold Climate Demonstration House (CCDH), a research and demonstration facility in Alberta. By comparing the effectiveness and practical use of different air and vapour retarder materials and techniques, it was found that for the air barrier, ADA materials and techniques were more easily installed. The resulting air seal was more reliable. However, until inspectors accept alkyd or vapor barrier paints as the vapor retarder, polyethylene is recommended. The construction techniques recommended in this report can be installed with a minimum of experience and with minimal involvement of other subtrades. The cost to provide an air/vapor barrier for a 1000 ft /sup 2/ bilevel with both levels fully developed (as demonstrated in the CCDH) was approximately $360. 26 figs.

40101 **(BA—031982) Guidelines for energy conscious roof design.** (Info-Tech, Calgary, Alberta (Canada)). Mar 1982. 116p. (CE—01711). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

This report provides guidelines to assist in the selection of an appropriate roofing system and in the selection of optimum amounts of suitable insulation in Canada. The generally available types of insulated roofing systems are listed and described. The energy implications of roofing and flashing systems are also noted, and the advantages and disadvantages of each system are listed. Recommended designs and construction methods are given, along with comments on the supervision and maintenance of each system. Roofs can be divided into flat and watershedding types, the latter to be preferred where practical. Watershedding roofs are relatively trouble-free but pose structural problems if large roof areas need to be covered. Therefore flat roofs are commonly found on large buildings, but this type of roof is more prone to leakage and other problems if not installed properly. Energy implications of roofs lie in the fact that a good way to save energy is to install sufficient insulation on or in the roof. The kind of insulation, its thickness, strength, weather resistance and thermal properties all have serious implications on the choice of roofing and vice versa. Insulation of watershedding roofs is relatively easy, but flat roofs require dense, specialized, relatively expensive insulation which presents installation and maintenance difficulties if installed on the outside of the roof. Insulation installed inside both types of roofs may present problems from penetration of the insulation by the roof truss system. 17 refs., 30 figs.

40102 (BCU—64-8119) **A feasibility study of solar lighting in multi-storey buildings by means of a low-loss light guide. A final report.** Nodwell, R.A.; Brown, D.N.; Whitehead, L.A. (British Columbia Univ., Vancouver (Canada)). Nov 1982. 48p. (CE—01672). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

An examination of a novel light distribution system for office buildings has been carried out using a prism light guide system. A total of two papers from this report have been abstracted.

40103 (BCU—64-8119, pp 16) **A new efficient light guide for interior illumination.** Whitehead, L.A.; Nodwell, R.A.; Curzon, F.L. Nov 1982. British Columbia Univ., Vancouver, Canada. (CE—01672).

In A feasibility study of solar lighting in multi-storey buildings by means of a low-loss light guide. A final report.

Experimental and theoretical studies of a recently patented prism light guide are described. This device combines the total internal reflection of optical fibres with the low attenuation of air transmission of light. Since it can be moulded from acrylic plastic, the cost of the guide is low enough to make large scale interior illumination with piped light feasible. The operation of the prism light guide has been demonstrated experimentally, in complete agreement with a simple theroretical model. Moreover, the quality of pipe which was produced by press moulding of acrylic plastic is already high enough to compete very favourably with other available types of light guide. 8 ref., 4 figs.

40104 (BCU—64-8119, pp 32) **A feasibility study of solar lighting in multi-storey buildings by means of a low-loss light pipe.** Nodwell, R.A.; Brown, D.N.; Whitehead, L.A. Nov 1982. British Columbia Univ., Vancouver, Canada. (CE—01672).

In A feasibility study of solar lighting in multi-storey buildings by means of a low-loss light guide. A final report.

An examination of a novel light distribution system for office buidings has been carried out. This system uses the newly invented prism light guide (PLG) system. The PLG is a hollow, square pipe made of acrylic plastic with longitudinal prismatic corrugations. All light introduced within an entrance cone of 27.6/sup 0/ is totally internally reflected. The lighting system consists of a foor-top heliostat and concentrating mirror, a vertical mirrored shaft and a network of PLG for each illuminated area. The proposed supplementary lighting would be supplied by 1 kW lamps coupled to each 15 m of light pipe. The control system would be programmed to calculate the position of the sun, drive heliostats, measured wind velocity, solar flux, and cloud cover, and turn on the auxiliary lighting during perods with insufficient insolation. The report outlines the reasons for choosing the various components, how they might be manufactured, and their cost. Factors which influence the performance of the system are also discussed. The economic evaluation of the system reveals that, at the level of small scale production, a solar lighting system could be available in Canada by 1990 for 50% more than conventional lighting. The economics are more attractive in sunnier countries having higher electrical costs. 29 refs., 9 figs., 6 tabs.

40105 (BNL—41067) **Overview of tracer technology instrumentation for short-term and real-time building ventilation determinations.** Dietz, R.N. (Brookhaven National Lab., Upton, NY (USA)). Mar 1988. Contract AC02-76CH00016. 37p. (CONF-880375—1).

From AIVC workshop on measurement techniques; Koge, Denmark (22 Mar 1988).

An intercomparison of three real-time tracer technologies demonstrated the potential of in-the-field feedback on the determination of air infiltration and air exchange rates between multiple zones in buildings influenced by occupancy behavior and ventilation system changes. Some tracer technologies can also employ less-expensive, short-term measurement methods for subsequent laboratory determination of flow rates in these steady-state modes. In the build-up mode, both short-term and real-time measurements with these technologies can provide ventilation efficiencies and local ages of air. For short-term measurements, all but one of the technologies can use whole-air sampling; only the perfluorocarbon tracer (PFT) methodology is capable of adsorbent sampling. For real-time measurements, each technology uses field-deployable sampling and analyzing equipment. Tracer costs for implementing the PFT technology are more than 1000-fold less than for the SF_6 constant concentration tracer gas (CCTG) technique, more than 10,000-fold less than for the halocarbon (HC) electron capture detector-gas chromatograph (ECD-GC) technology, and more than 100,000- to 1,000,000-fold less than for the HC mass spectrographic (MS) approach. The number of tracers available in both the PFT (7), ECD-GC (6), and MS (4) technologies are potentially comparable, although cost and toxicity might limit the selection of HCs; the CCTG technique requires only 1 tracer but cannot readily measure multizone air exchange rates. 12 refs., 6 figs., 3 tabs.

40106 (BNL—52068-Vol.2, pp 235-252) **High temperature engineering plastics for use in condensing heat exchangers.** Morra, B.S.; Plucinsky, S.R. (Amoco Performance Products, Inc., Ridgefield, CT (USA)). Apr 1987. NTIS, PC A10/MF A01. Order Number DE88005230/JAW. (GRI—87/0091.2; CONF-8704247—Vol.2).

From International symposium on condensing heat exchangers; Columbus, OH, USA (14 Apr 1987).

The development of condensing heat exchangers for high-efficiency gas furnaces has surfaced certain material problems not encountered previously by the industry. The acidic environment of the condensate causes corrosion in traditional metals used for heat exchangers, and even in some more exotic, much higher-priced metal alloys. Because the operating temperatures in these secondary heat exchangers are considerably below those of the primary heat exchangers, the furnace manufacturer and finned-tube coil suppliers can now consider some of the newer, high-temperature engineering plastics for these applications. High-temperature engineering thermoplastics with high resistance to acidic environments are discussed. Not only do these materials offer the chemical resistance to the corrosive environments encountered in the heat exchangers, but their easy processibility by extrusion, injection molding or blow molding will allow the design engineer to be much more flexible in his thinking for new heat exchanger design. In addition, the cost and performance of the finished parts will be improved compared to existing designs and designs in which more exotic materials are planned to be used. Data are reviewed regarding the basic material properties of these thermoplastics which are pertinent to their use in heat exchangers.

40107 (BNL—52068-Vol.2, pp 253-267) **Development and evaluation of a high-efficiency boiler for the U.K. domestic market.** Allen, C.G. (Stelrad Group Ltd., Hull (England)). Apr 1987. NTIS, PC A10/MF A01. Order Number DE88005230/JAW. (GRI—87/0091.2; CONF-8704247—Vol.2).

From International symposium on condensing heat exchangers; Columbus, OH, USA (14 Apr 1987).

Boiler efficiencies have increased from about 70% to 80% since central heating gained popularity in the UK at the end of the 1950's. In order to step across the 80% efficiency threshold, a new approach was needed which would utilize the latent heat of condensation. The problems of corrosion, condensate disposal, and the need to provide mechanical ventilation needed to be solved. A research and development program was undertaken to develop a high-efficiency condensing boiler to meet the very special needs of the United Kingdom. The program of work was aimed at achieving a dimensionally compact design since, unlike heating systems in both mainland Europe and in the USA, the central heating boiler is installed in the kitchen in the vast majority of cases. For the same reason, a low noise level was required if consumer complaints were to be negligible. It was important to assess whether high-efficiency condensing boilers could be used in the boiler replacement market without the need to increase radiator surface area. Other topics covered are the effects of laboratory air conditions on measured efficiency and the effect this has on standards, and the advantages of drawing combustion air from outside the building. The results of laboratory and field testing are discussed, showing that high-efficiency condensing boilers can give bench efficiencies in excess of 90% (higher heating value) and year-round efficiencies of approximately 85% in normal sized systems.

40108 (BNL—52068-Vol.2, pp 269-283) **Development of condensing type high-efficiency gas absorption chiller/heater.** Kannoh, S.; Kurosawa, S.; Takemoto, S.; Takabatake, S. (Osaka Gas Co., Ltd. (Japan)). Apr 1987. NTIS, PC A10/MF A01. Order Number DE88005230/JAW. (GRI—87/0091.2; CONF-8704247—Vol.2).

From International symposium on condensing heat exchangers; Columbus, OH, USA (14 Apr 1987).

In Japan, it has been more than 17 years since the double-effect type gas absorption chiller/heater was developed for building air-conditioning. This type of unit has been increasing in popularity year by year for the reason of low cost, energy saving and ease of operation, and it has occupied a large market share in central air-conditioning buildings. However, a highly efficient motor-driven chiller and heat pump have been put on the market, and competition is now becoming keener in an energy-saving aspect. Consequently, in order to save more energy than with the current absorption chiller/heater, a condensing type high-efficiency gas absorption chiller/heater is being developed for the purpose of recovering the latent heat in the exhaust gas to enhance the cooling/heating efficiency. This system makes it possible to achieve a cooling C.O.P. of 1.3 (for approximately 1.0 at the conventional double effect type), and heating C.O.P. 0.95 (for 0.85 at the conventional type). Further, in order to select the optimum corrosion-resistant material for a condensing type heat exchanger, long-term durability tests for different types of materials are being performed. This project started in 1984, a prototype of 100 RT was designed and manufactured in 1986, performance tests followed in 1987. This project will be completed early in 1988. The condensation heat recovery effect, and the interim evaluation of long-term durability tests for various materials which are being tested in Osaka Gas R & D center are discussed.

40109 (BNL—52068-Vol.2, pp 285-303) **Condensing heat exchanger for an absorption-type heat pump.** Muehlmann, H.P.; Wessing, W. (Ruhrgas AG, Essen (West Germany)). Apr 1987. NTIS, PC A10/MF A01. Order Number DE88005230/JAW. (GRI—87/0091.2; CONF-8704247—Vol.2).

From International symposium on condensing heat exchangers; Columbus, OH, USA (14 Apr 1987).

For gas-fueled, single-stage burner, air-to-water absorption-type heat pumps for residential applications (designed for ammonia/water operation), Ruhrgas investigated the use of condensing heat exchangers to improve the efficiency of the heat pump. Following laboratory work on a wide range of different heat exchanger designs, Ruhrgas field-tested a finned-tube aluminum (AlNgSi 0.5) heat exchanger which was installed in the flue systems of ten different heat pump installations for 35,000 hours. The average increase in useful heat output achieved by the condensing heat exchanger was 10%. The coefficient of fuel utilization correlating heat input and useful heat output was also improved by an average 10%. For continuous operation, the average coefficient of utilization was 1.124 for a space heating system operating at a flow temperature of 158°F and a return temperature of 122 to 68°F and 1.237 for a space heating system operating at flow and return temperatures of 113°F and 95 to 68°F, respectively. The space heating water passing through the countercurrent flow heat exchanger absorbed an average 68% of the heat carried by the flue gas. An increase in the size of the heat exchanger surfaces improved this ratio to more than 80%, but the improved heat transfer from flue gas to the space-heating water did not raise the coefficient of fuel utilization substantially, showing that the small increase in efficiency does not warrant the cost of the large heat exchanger. The optimum condensing heat exchanger size was 1.7 square feet for each kilowatt of heat pump rating.

40110 (BNL—52068-Vol.2, pp 305-316) **Condensing boiler with reheated flue gases.** Naeslund, M. (Lund Institute of Technology (Sweden)). Apr 1987. NTIS, PC A10/MF A01. Order Number DE88005230/JAW. (GRI—87/0091.2; CONF-8704247—Vol.2).

From International symposium on condensing heat exchangers; Columbus, OH, USA (14 Apr 1987).

Natural gas was introduced in Sweden as late as 1985 and condensing boilers will primarily replace oil-fired boilers. The demand for a corrosion-resistant lining in the chimney is obvious. To install a new lining could, however, economically spoil the benefit of a condensing boiler despite its high efficiency. A method was developed and tested to prevent continuing condensation of water vapor in flue gases from a condensing boiler by reheating gases immediately before they reach the chimney. A commercially available boiler, the Dutch Remeha 1HR, has been modified according to the method and tested. In laboratory tests the method was proven, and a comparison of seasonal efficiency with and without reheating was made. In this special case the seasonal efficiency is unchanged. However, a loss of efficiency is expected when flue-gas temperature is increased, but the loss does not necessarily have to be as high as the reheating indicates. Reheating of the flue gases is done by locating a new heat exchanger in the boiler. The new heat exchanger has flue gases on both sides, and flue gases are reheated after condensation.

40111 (BNL—52068-Vol.2, pp 317-331) **Condensing system for combined space and water heating.** Hayden, A.C.S.; Preto, F.; Sullivan, H.F.; Briggs, R.J.; Wright, J.L. (Canadian Combustion Research Lab., Ottawa, Ontario). Apr 1987. NTIS, PC A10/MF A01. Order Number DE88005230/JAW. (GRI—87/0091.2; CONF-8704247—Vol.2).

From International symposium on condensing heat exchangers; Columbus, OH, USA (14 Apr 1987).

Domestic space heating and tap hot water heating are the two major components in residential energy use. Combined space/water heating appliances offer major energy and equipment savings and increased suitability for low energy housing. The innovative features and performance testing of an experimental prototype condensing system are described. Although the prototype is designed for forced-air systems, it can easily be adapted for hydronic operation. This system is based on a standard storage type gas-fired commercial water heater (DHW) and contains two additional major components: a condensing water preheat tank and an air blower/finned coil unit. Hot flue gas leaving the water heater is passed through tubes within the preheat tank and cooled by water flowing around the tubes. This condenses most of the water vapor in the flue gases, which are subsequently exhausted via an induced draft fan. The preheated water is then fed to the DHW tank. There the water is further heated in order to meet domestic hot water and/or space heating requirements. The tap water temperature can be varied by adding mains water. When necessary for space heating, water from the DHW tank is pumped through a finned coil heat exchanger/air blower unit and returned to the inlet of the preheat tank. In the performance tests, the water heater was able to provide adequate space heating and domestic hot water (up to 7.5 liters per minute). Thermal efficiency tests indicated that the system functioned with efficiencies of 92% and 98%, based on the higher heating value, when operated in the space heating and hot water heating modes, respectively.

40112 (BNL—52068-Vol.2, pp 333-348) **Performance of domestic oil-fired condensing systems.** Preto, F.; Lee, S.W.; Hayden, A.C.S. (Canadian Combustion Research Lab., Ottawa, Ontario). Apr 1987. NTIS, PC A10/MF A01. Order Number DE88005230/JAW. (GRI—87/0091.2; CONF-8704247—Vol.2).

From International symposium on condensing heat exchangers; Columbus, OH, USA (14 Apr 1987).

The major impediment to development of high-efficiency condensing oil-fired furnaces has been the fact that flue-gas condensate from oil-fired equipment is extremely corrosive and can cause excessive fouling. In recent years, new technologies have emerged which attempt to circumvent these problems by using special materials and/or condensation strategies. The Canadian Combustion Research Lab has carried out performance testing of three condensing oil-fired units. Unit R is a retrofit system which sprays the flue gases with a high pressure water jet. Unit F is a forced-air furnace equipped with an advanced stainless-steel heat exchanger. Unit B is a stainless steel boiler designed from combined space and tap hot water heating. In Unit B, condensation is facilitated by a water bath. All three systems produce low-temperature flue gas and consequently no chimney is required. Combustion products are vented through an outside wall with a plastic pipe and condensate is sent to the drain. Due to the use of water jets, the condensate produced

by Units R and B is diluted prior to being discharged. The condensate drain of Unit F can be connected to an acid neutralizer prior to discharge. Laboratory tests were carried out on all three systems to measure their performance under both steady state and variable cyclic operation. In steady state operation all furnaces tested above 90% thermal efficiency. The seasonal efficiency of condensing furnaces is very similar to their steady state efficiency, with negligible transient effects.

40113 (BNL—52068-Vol.2, pp 359-371) **Field performance study of four residential high-efficiency condensing gas furnaces.** Stauder, F.A.; Dumouchel, P.E.; Jones, J.M. (Union Gas Ltd., Chatham, Ontario (Canada)). Apr 1987. NTIS, PC A10/MF A01. Order Number DE88005230/JAW. (GRI—87/0091.2; CONF-8704247—Vol.2).

From International symposium on condensing heat exchangers; Columbus, OH, USA (14 Apr 1987).

Commencing in October 1981, Union Gas Limited, with assistance from the Ontario Government, undertook a field test program to evaluate the installation and operating characteristics of four commercially available high-efficiency condensing residential furnaces. The intent of the program was to promote the advancement of high-efficiency condensing gas heating equipment technology in Canada by providing in-situ field performance data and installation experience to Union's Marketing and Service personnel, manufacturers, governments, and the general public/consumers. The findings of the in-situ field tests are reported. Comments on the integrity of the furnace and associated heat exchangers are presented. Measures of performance such as annual energy savings and seasonal furnace operating efficiency are also presented.

40114 (BNL—52068-Vol.2, pp 373-389) **Application of condensing boilers in the Netherlands.** Bartholomeus, P.H.J. (N.V. Nederlandse Gasunie, Groningen (Netherlands)). Apr 1987. NTIS, PC A10/MF A01. Order Number DE88005230/JAW. (GRI—87/0091.2; CONF-8704247—Vol.2).

From International symposium on condensing heat exchangers; Columbus, OH, USA (14 Apr 1987).

In 1979, the N.V. Nederlandse Gasunie introduced a prototype condensing central-heating boiler in the Netherlands. This idea for reducing gas consumption for space heating was enthusiastically adopted by the Dutch appliance manufacturers. Introduced in 1980, the condensing boiler has now gained its place in the market; 90,000 units have been installed in households and over 2000 in collective installations. This principle is also being applied now outside the Netherlands, in Western Europe. In the past six years, a wealth of experience has been gained with condensing boilers, particularly in relation to installation problems, corrosion, maintenance, gas economy, and market acceptance. The future demands further developments. In spite of the fact that natural gas is the cleanest fossil fuel, industry is working to further reduce pollutant emissions, for example, by the use of low-NO/sub x/ burners. Also, a better regulation of the gas-air ratio can improve the boiler performance. Such techniques are currently being developed for application in condensing appliances. The condensing boiler has also proven to be an excellent means of producing hot water. Recent research has led to the development of a high-efficiency, indirectly fired storage heater. The results of this research are discussed.

40115 (BNL—52068-Vol.2, pp 391-409) **Condensing boilers in France: computational methods for condensers, new appliances, and field experience.** Pelloux-Prayer, D. (Gaz de France, St. Denis). Apr 1987. NTIS, PC A10/MF A01. Order Number DE88005230/JAW. (GRI—87/0091.2; CONF-8704247—Vol.2).

From International symposium on condensing heat exchangers; Columbus, OH, USA (14 Apr 1987).

The use of condensing boilers for residential heating has been expanding in France since 1979. Some of the latest studies of Gaz de France in this field are presented. A simplified method of computation for water irrigated condensers has been perfected. It is possible to calculate easily the heat transfer coefficient in the wet zone if this coefficient in the dry zone is known. The efficiency of condensing boilers can be predicted without complicated calculations, with an accuracy of +/- 1%. New appliances have appeared: boilers using cold water or combustion air in order to increase efficiency (92 to 96% efficiency for inlet/outlet temperatures of heating water of 122/158°F); an air heater providing both warm air (7 kW output) and hot water by accumulation. Field experience proved that seasonal space-heating efficiency is very close to estimates. In most cases, resistance to corrosion is satisfactory.

40116 (BNL—52068-Vol.2, pp 411-431) **Simulation model as a design tool for finned-tube condensing heat exchangers.** Fischer, R.D.; Stickford, G.H. Apr 1987. NTIS, PC A10/MF A01. Order Number DE88005230/JAW. (GRI—87/0091.2; CONF-8704247—Vol.2).

From International symposium on condensing heat exchangers; Columbus, OH, USA (14 Apr 1987).

A computer model of a finned-tube condensing heat exchanger for a forced-air gas furnace is described. The controlling heat transfer phenomena in condensing heat exchangers in gas furnaces are considerably different than in conventional condensers with a single fluid because of the presence of non-condensible gases. The model assumes a single pass of flue flow in parallel through up to 10 rows of tubes with air in cross flow through finned surfaces. Calculations begin at the tube entrance, and fluid properties and heat transfer are determined by marching step-by-step along the tubes. Vapor transport from the saturated flue gas to the cool inner tube wall is characterized by a diffusion coefficient and the Colburn-Hougen relationship for condensing in the presence of a non-condensible gas. The computer model was calibrated by comparison with measured data. For this calibration, the air- and gas-side heat transfer coefficients were adjusted, along with the mass transfer diffusion coefficient, to achieve agreement between predicted and measured performance (outlet flue-gas temperature, condensate flow rate, and overall efficiency). The model was then used to predict performance for a matrix of heat exchanger design parameters. Results from this matrix of runs showed that furnace efficiency is strongly affected by the number of tubes in a row, excess air, and twisted tapes in the tubes. Furnace efficiency remained relatively constant when increasing the tube diameter by 1.6 and decreasing the number of tube rows from 3 to 2. The model predicted condensing (wet-wall) conditions over virtually the entire length of the tubes for the range of geometry and flow conditions. Thus, it appears possible to design a finned-tube heat exchanger that remains wet on all condensing surfaces, which will minimize the possibility of corrosion.

40117 (BNL—52068-Vol.2, pp 433-440) **Update on U.S. DOE efficiency test procedures for condensing furnaces and boilers.** Talbott, J.M. (Dept. of Energy, Washington, DC (USA)). Apr 1987. NTIS, PC A10/MF A01. Order Number DE88005230/JAW. (GRI—87/0091.2; CONF-8704247—Vol.2).

From International symposium on condensing heat exchangers; Columbus, OH, USA (14 Apr 1987).

The US Department of Energy (DOE) was directed by Congress to prescribe test procedures for various household consumer products, including household furnaces and boilers. These procedures are the only accepted basis of comparison regarding energy efficiency and energy consumption for residential furnaces and boilers distributed in the US. Based on existing flue loss procedures, DOE issued test procedures for non-condensing furnaces and boilers in 1978. In 1980, DOE issued test procedure amendments which included a flue loss testing procedure for condensing furnaces and boilers. This procedure represented minimal burden to the manufacturer and is reasonably accurate for some units, i.e., condensing units with relatively low flue temperatures. However, for other units this procedure, as well as other flue loss procedures, would predict that there is little or no creditable condensation occurring, even though significant amounts of water condensate would be produced by the unit under steady-state and cyclic testing. Consequently, DOE issued an optional procedure allowing actual collection of the condensate during representative cycling to determine the efficiency improvement due. An explanation of the mathematical formulation and theoretical basis of both methods are discussed, as well as the work done by the National Bureau of Standards (NBS) regarding the technical specification of a condensate collection procedure. Particular attention is paid to the problem of collected condensate variability. Also discussed are the test procedures

used in other countries with particular attention given to how these procedures contrast to the US DOE procedures.

40118 **(BNL—52133) Modular cogeneration in district heating and cooling systems.** Andrews, J.W.; Aalto, P.; Gleason, T.C.J.; Skalafuris, A.J. (Brookhaven National Lab., Upton, NY (USA)). Dec 1987. Contract AC02-76CH00016. 65p. NTIS, PC A04/MF A01;1; GPO Dep. Order Number DE88009914/JAW.

The use of prepackaged cogeneration systems of modular size (100 kWe - 10 MWe) in conjunction with district heating and cooling is proposed as a way to enhance the energy conservation potential of both cogeneration and district energy systems. This report examines the technical and institutional aspects of this marriage of technologies, and develops a research agenda whose goal is to define this potential use of cogeneration more accurately and to develop the generic technology base needed to bring it to actuality. 11 refs.

40119 **(BNL—52134) Metal buildings study: performance of materials and field validation.** Loss, W. (Brookhaven National Lab., Upton, NY (USA)). Dec 1987. Contract AC02-76CH00016. 73p. NTIS, PC A04/MF A01;1; GPO Dep. Order Number DE88011536/JAW.

A 5000 square-foot metal building located at Brookhaven National Laboratory has been monitored over a winter season. Energy flows through wall sections were monitored using portable calorimeters. Air infiltration was measured using perfluorocarbon tracers, and the associated heat losses were calculated. Slab losses were assessed through a comparison of measured temperature gradients with results obtained through the use of heat-flow meters. The effect of thermal bridges and compressed insulation in locations where support beams are joined to the exterior skin was found to increase heat losses significantly. A retrofit strategy including spray insulation of beams is projected to save 30% on heating energy.

40120 **(CMHC—101982) Translation of CMHC-2 energy analysis program for use on a microcomputer.** (Canada Mortgage and Housing Corp., Ottawa, Ontario). Oct 1982. vp. (CE—01724). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

This document presents the design of the CMHC microcomputer energy analysis system for houses. The system, designed to function on a microcomputer, is an outgrowth of the CMHC-2 (Computer Model for Heating Cost effectively) mainframe energy analysis system. The purpose of the system is to provide access to home heating energy conservation decision information. The software is to meet certain criteria, including cost of about $1,000, ability to run on computers costing in the $4,000-8,000 range with at least 48K RAM and disk memory of 200K. The system will provide reports which lead to decisions based upon technical analyses of energy consumption, current costing information, and financial analysis techniques. Operation of the system is to be user friendly; operation decisions will be menu based, with data input by full-screen editors. This report describes the system from the user point of view. It examines the outputs, data inputs and how they are accepted, and the system features and system operation. Sample formats and screens are shown throughout the report.

40121 **(CRD—081979) Development of a hybrid heat pump. Final report.** (Chromalox Research and Development, Mississauga, Ontario (Canada)). Aug 1979. 49p. (CE—01335). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

A hybrid heat pump, consisting of a natural gas furnace with a refrigeration coil placed in the furnace return air duct, was designed, fabricated and laboratory tested. The furnace design incorporated a by-pass duct, in parallel with the furnace heat exchanger, and a damper to control the volume of air passing over the heat exchanger. An electric pilot igniter and a stack damper were included in the design to protect the furnace heat exchanger from corrosion. The prototype heat pump was built, and tested under steady state conditions. The correct airflow over the refrigeration coil and furnace heat exchanger was achieved by adjusting the damper position. The heat pump output capacity was 31,000 Btu/hr. and the C.O.P. was 3.14 at the 47/sup 0/F rating point. The measured steady state performance data was corrected to compensate for inefficiencies which were introduced by the heat pump cycling. An economic evaluation was performed using the modified performance data. The analysis showed that the hybrid heat pump is cost effective, compared with conventional furnace/air conditioner combinations, on the basis of life cycle costs in Toronto. The advantage of the hybrid, compared with an all-electric heat pump, is that electrical input is not required during the load peaks of the electrical utilities. 19 figs., 5 tabs.

40122 **(CU—031983) HUDAC 1981 energy conserving show homes energy performance monitorin annual report: energy use analysis and performance evaluation of ten energy conserving houses in Calgary and Edmonton, Alberta.** Youso, M.J.; Hicklin, J.N.; Eng, D. (Calgary Univ., Alberta (Canada)). Mar 1983. 118p. (CE—01527). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

To quantify the performance of ten houses designed and built in Alberta as a demonstration project to incorporate energy conserving features and construction techniques, a monitoring methodology was used to define performance criteria for comparison among the houses. A comparative evaluation was carried out, based on energy consumption using performance indices of energy consumed and effective R value. The methods used for comparing the performance of the houses involved the use of a computer simulation model for estimating residential energy consumption, and an analysis of the actual energy consumption of the houses based on utility records. This report assesses the performance of these houses in 1982, and describes the analytical methodology and a microcomputer-based electronic device for cost effectively evaluating the efficiency of energy use in residences. Circuit diagrams, operation and calibration procedures, and programming for this device are all presented in detail. The analytical method has been applied to data from utility records to calculate performance indices for the ten study houses. As well, this methodology has been developed into an instrumented monitoring system comprising real-time analysis, recording, and display instrumentation. The analyses of the utility records show that the total energy used by seven of the ten houses during 1982 was between 110 and 150 GJ. This could be considered as approaching minimum standards for low energy housing of this size. The energy consumption of the other three houses are typical of average or standard housing. In these cases, the advantages of increased insulation levels and more efficient furnaces are offset by larger than average heated volumes. 12 refs., 16 figs., 65 tabs.

40123 **(DOE/ID/12584—19) Protocol for the estimation of average indoor radon-daughter concentrations: Second edition.** Langner, G.H. Jr.; Pacer, J.C. (UNC Geotech, Grand Junction, CO (USA)). May 1988. Contract AC07-86ID12584. 39p. (UNC/GJ—09(TMC)). NTIS, PC A03/MF A01; GPO Dep. Order Number DE88010379/JAW.

The Technical Measurements Center has developed a protocol which specifies the procedures to be used for determining indoor radon-daughter concentrations in support of Department of Energy remedial action programs. This document is the central part of the protocol and is to be used in conjunction with the individual procedure manuals. The manuals contain the information and procedures required to implement the proven methods for estimating average indoor radon-daughter concentration. Proven in this case means that these methods have been determined to provide reasonable assurance that the average radon-daughter concentration within a structure is either above, at, or below the standards established for remedial action programs. This document contains descriptions of the generic aspects of methods used for estimating radon-daughter concentration and provides guidance with respect to method selection for a given situation. It is expected that the latter section of this document will be revised whenever another estimation method is proven to be capable of satisfying the criteria of reasonable assurance and cost minimization. 22 refs., 6 figs., 3 tabs.

40124 **(EI—071982) Lighting energy conservation from labelling switches. A study. Phase 2. Final second interim report.** (Enermodal Engineering Ltd., Waterloo, Ontario (Canada)). Jul 1982. 81p. (CE—01720). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

The greatest potential for lighting energy savings in the commercial sector is in existing buildings. This document presents a research proposal to examine possible savings through the proper use of wall switches. A literature survey was undertaken, and an annotated bibliography is included. This survey revealed few studies directly related to the labelling of switches, although a number of studies investigating human behavior modification indicated that labels alone may be less effective than some kind of comprehensive behavior modification approach. A number of designs are presented for experiments to be used to determine the effect of wall switch labels on energy savings and a survey was conducted in Toronto to find suitable office buildings in which to locate the experiments. A new and inexpensive device for monitoring the use of lighting systems was tested and found satisfactory. Costing data for the experimental project are included. 47 refs., 13 figs., 9 tabs.

40125 **(EI—101982) Use of central control and monitoring systems in school buildings.** (Engineering Interface Ltd., Willowdale, Ontario (Canada)). Oct 1982. 44p. (CE—01667). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

A school in Ontario with higher-than-average energy consumption is studied as an example in order to determine the protential for using computer control systems for energy conservation in school buildings. The total annual energy consumption for the school costs $260,000/y. Recommended energy conservation actions are classified in two categories. The first category, not lending itself to computer control, includes rebalancing air supply, reducing domestic hot water temperture, shutting condenser and chilled water pumps, and modifying the lighting system. Potential savings from this category of actions are $25,400 per year, and the initial capital cost is $5,500. The second category includes actions which could benefit from computer control: timing the operation of fans and pumps, and minimizing the reheat of supply air. Potential savings from this categroy of actions are $63,700 per year, and the required initial investment depends on the control method chosen. Minimizing reheat is best done by modifying pneumatic controls and requires an initial investment of 42,500. The timing functions can be executed according to the following options: manually for zero initial cost, with timeclocks for an initial cost of $2,400, with central electronic timing for an initial cost of $5,600, or with a small local computer for an initial capital cost of $12,200. Since expected energy savings pay quickly for the initial investment, first cost considerations do not seem to play an important role in the decision on the choice of a control system. Non-economic considerations such as convenience, ease of use, reliability, flexibility and expandability determine the choice of control method. 7 figs., 7 tabs.

40126 **(EUR—10285-EN) Basic characteristics for low-cost houses in order to reduce the energy consumption for heating. Synthesis report.** Dupagne, A. (Commission of the European Communities, Luxembourg. Directorate General Information Market and Innovation). 1985. 58p. Commission of the European Communities, Luxembourg. Office for Official Publications of the European Communities.

Energy.

In collaboration with CSTC, Belgium, TNO, Netherlands and BRE, UK a practical energy saving design methodology, based on a steady state simulation model for the behaviour of houses (LPB 3-4) has been developed in the First Energy Conservation R + D Programme (1975-1979). This methodology has been used for the design and construction of eight houses. The aim of this project was to validate the existing steady state model and to improve the design methodology by including simulation of the dynamic thermal behaviour of buildings (LPB 5) and by developing a conversational computerized version of the design guidelines. Also the investment, operating and maintenance cost has been included. After detailed design and construction, measurements have been carried out in five of the eight houses. In this monitoring project the measuring methodology was given priority. Simultaneously the design methodology has been computerized and is now available in the form of a users guide. (orig.)

40127 **(EUR—10683) European passive solar handbook. Basic principles and concepts for passive solar architecture. Preliminary edition.** Achard, P.; Gicquel, R. (eds.). (Commission of the European Communities, Brussels (Belgium). Directorate General for Research, Science and Development). 1986. 301p. Commission of the European Communities, Luxembourg. Office for Official Publications of the European Communities.

The European Communities inform about passive solar buildings in Europe as well as about the particular features and aspects of energy conservation on the basis of passive solar heating systems. A survey of the basic principles of solar architecture is followed by a discussion of the physico-meteorological principles (heat transfer, climates, thermal comfort) and thermal analyses (heat losses, humidity, condensation, casual gains). Access is given to passive solar design strategies and tools as well as to 17 solar buildings to be found in Europe (solar architectural features, specifications). The six chapters contained in the manual have all been abstracted separately. (HWJ).

40128 (EUR—10683, pp 2.1-2.33) **Section 2: Fundamentals. Fundamentals of heat transfer - climate - thermal comfort - climate, comfort and building.** 1986. Commission of the European Communities, Luxembourg. Office for Official Publications of the European Communities.

In European passive solar handbook. Basic principles and concepts for passive solar architecture. Preliminary edition.

Thermal comfort in accordance with the interaction between residential buildings and the more or less rough environmental conditions they are exposed to cannot be achieved but with the help of detailed data on climates, heat flows and the extent of thermal comfort. Along with numerous diagrams and tables a survey facilitates access to the fundamentals of heat transfer (radiation, convection, condition of heat), climates (Europe, solar radiation, ambient temperatures, wind, precipitations, local climates and their effects on the topography, surfaces of water, soils and vegetation), thermal comfort (activity levels, clothes, ambient temperatures, radiation temperatures, air movements, humidity), as well as to the interaction of thermal comfort and building structures, sun and shade, wind and shelter, development of outdoor climates and bioclimatic diagrams (psychrometry). (HWJ).

40129 (EUR—10683, pp 3.1-3.21) **Section 3: Building thermal analysis.** 1986. Commission of the European Communities, Luxembourg. Office for Official Publications of the European Communities.

In European passive solar handbook. Basic principles and concepts for passive solar architecture. Preliminary edition.

Heat supply, heat storage and heat losses contribute to the heat balance of buildings. Along with practical illustrated examples and additional diagrams and tables, a detailed description refers to the practical relevance of each of the three parameters. The paper deals with heat losses (thermal insulation, placement and position of insulation, thermal bridges), infiltration and ventilation (choice of means, air flow through openings, infiltration and natural ventilation, doors, windows, energy consumption), humidity (water vapour generation, moisture evacuation), condensation (vapour barriers, surface condensation), as well as with casual gains such as heat supply from occupants, heat gains from domestic hot water and heat gains due to appliances. (HWJ).

40130 (EUR—10683, pp 4.1-4.51) **Section 4: Passive solar building.** 1986. Commission of the European Communities, Luxembourg. Office for Official Publications of the European Communities.

In European passive solar handbook. Basic principles and concepts for passive solar architecture. Preliminary edition.

A heavily illustrated survey facilitates access to the concepts the realization of passive solar systems is based on. Reference is made to solar collection (orientation, reflectors, materials, movable

insulation, shading), solar storage (materials, material thickness, effect of the mass), heat distribution, daylighting, and visual comfort (level of illuminance, glare). A discussion of passive solar configurations such as heating systems (direct and indirect gains, isolated gain), cooling systems and combining systems is followed by sizing examples. The final chapter is dedicated to auxiliary heating systems (system selection, system design, heat emission and comfort, integration of building and heating system, dynamic behaviour and control, user education). (HWJ).

40131 (IBP-BS—138/86) Heating systems and noises. A collection of materials accompanying the heating systems seminar of the Esslingen Technical Academy, April 9 to April 11, 1986. Fuchs, H.V. (Fraunhofer-Institut fuer Bauphysik, Stuttgart (Germany, F.R.)). 20 Mar 1986. 55p. (In German). Fraunhofer-Institut fuer Bauphysik, Stuttgart (Germany, F.R.).

The pamphlet contains a collection of materials accompanying the Heating Systems Seminar which took place at the Esslingen Technical Academy from April 9 to April 11, 1986. Apart from discussing the fundamentals of acoustics, i.e. airborne, structure-borne and footfall sound, the pamphlet deals with requirements as regards the sonics of heating systems. The planning aspects discussed mainly refer to layouts, the insulation of structure-borne and airborne sounds, and the absorption of airborne sounds. Final remarks concerning the minimization or avoidance of heating systems noises are addressed to heating systems manufacturers.

40132 (K/CSD/TM—78) Analysis of seven thermal bridges identified in a commercial building. Childs, K.W. (Oak Ridge Gaseous Diffusion Plant, TN (USA)). Jun 1988. Contract AC05-84OR21400. 38p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88011370/JAW.

Seven thermal bridges occurring in a large modern office building are identified. The impact that these bridges have on building envelope heat flow and minimum interior surface temperature is investigated using a finite-difference heat transfer computer program. Assumptions that are made in the development of two- and three-dimensional numerical models are discussed. Steady-state numerical models are employed to determine parameters that can be used to calculate corrections to the values for heat flow and interior surface temperatures obtained from one-dimensional analyses. The need for a means of characterizing the dynamic thermal response of bridges is also discussed, and two different numerical approaches to the calculation of response factors (or conduction transfer functions) are explored. 5 refs., 9 figs., 5 tabs.

40133 (MA—BETT8201) Energy conservation and house basements. A research report. A review of the effects of energy conservation measures on low-rise residential basements. (Middleton Associates, Toronto, Ontario (Canada)). Oct 1982. 143p. (CE—01709). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

This study examines techniques of saving energy in the construction and retrofitting of basements in low-rise residential buildings. The principal types of basement construction are reviewed with attention to inherent structural problems relevant to the installation of thermal insulation. The soil conditions can often threaten the long term integrity of the basement. Once the insulation is placed adjacent to the basement walls, it can change the soil and water behavior and cause structural damage. The diverse techniques for installing basement insulation are examined, whether applied externally or internally, and their relative advantages and disadvantages are compared. The problems in installing vapor barriers are also described. A final section discusses the economics of basement installation. This section confirms the economic advantages of insulating basements, where the cost can be recuperated in 1.2 to 7.3 years, depending on the local climate, heating costs, and type of insulation installation. An annotated bibliography is included. 55 refs., 41 figs., 9 tabs.

40134 (MEM/CRE—1983) Low energy bermed housing, Shoal Lake, Manitoba. (Manitoba Dept. of Energy and Mines, Winnipeg (Canada). Conservation and Renewable Energy Branch). 1983. 51p. (CE—01437). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

A low energy house with earth berms was constructed in Manitoba. The unique features of this home are earth sheltering over the majority of exterior walls, all windows triple glazed and with southern exposure, insulation values far exceeding current standards, entrances protected from direct exposure to the outdoors, well sealed air/vapor barrier, heat retaining atrium, and built-in provision for an active solar system. During a site visit, an air leakage test was performed using an infiltrometer and results are shown in an appendix. The major objectives of the builder were to provide adequate comfortable living space with short term additional cost but long range economic payback as a result of energy conservation using appropriate construction methods to achieve this, to use electric power as a major energy source with supplementing or complementing solar and wood heat, to increase public acceptance of underground or semi-underground accommodation by demonstrating that comfortable conditions can be achieved, to utilize pressure treated wood for the construction of underground earth retaining walls, and to attract greater public attention to the need for alternate energy sources and to the new or revised technologies to be considered in building and construction. It is unfortunate that one of the objectives, to use a pressure treatment wood underground wall, was not met. In future home building, this technique should still be carefully considered in terms of life cycle cost compared to conventional concrete basements. It is felt that the listed objectives will be fulfilled, assuming the public and other builders are made aware of the project. 39 figs., 7 tabs.

40135 (MEM/CRE—MG11457) Waste heat recovery. Elm Creek Curling Club, Elm Creek, Manitoba. (Manitoba Dept. of Energy and Mines, Winnipeg (Canada). Conservation and Renewable Energy Branch). Jun 1983. 10p. (CE—01514). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

The Elm Creek Manitoba Curling Club received funding to assist in the construction of an energy conserving heating system for the town's curling rink and skating arena complex. The system recovers waste heat produced by the artificial ice plant and distributes it via hot water for space heating of the curling rink lobby, playing areas and the waiting and dressing rooms of the natural ice hockey arena. In conventional ice plant operations, the heat extracted from the ice surface is exhausted outdoors. By recovering this heat the club has eliminated the need for any other heating fuel. Based on comparison with other arena complexes, simple payback within three years is possible. Some problems were encountered with the system as originally designed and built. During warmer periods, more heat was recovered than could be distributed or stored. The original design has been altered so that this excess heat is now dumped through a bypass line, to an outdoor cooler. Water leakage from the system storage cisterns was the other major problem; a result of faulty construction. This has been repaired. Operating experience since has been quite satisfactory. This report describes the design and operating experience at Elm Creek and recommends improvements as a guide for others considering the incorporation of similar systems at other facilities. The importance of proper engineering design and construction is stressed. 5 figs.

40136 (MLEPS—041982) A study to determine contaminant build-up in houses. (MacLaren Engineers, Planners and Scientists Inc., Willowdale , Ontario (Canada)). Apr 1982. 178p. (CE—01728). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

A study was conducted to monitor contaminant buildup in a number of houses in the Toronto area over the 1981-82 heating season. The primary objectives of the study were to determine the concentration of radon, radon daughters and formaldehyde in single family detached houses having low natural ventilation rates, to de-

termine the sampling frequency required to establish the profile of air contaminants that exist in houses during the heating season, and to ascertain whether a more extensive survey is warranted. The main observations and conclusions are as follows. There appeared to be positive correlations between daily infiltration rates obtained by tracer gas measurements and the square root of the indoor/outdoor temperature difference, and between infiltration rates and wind speeds. A distinct monthly variation in overall average infiltration rates is evident, showing good correlation with degree-day months and average wind speed data. Average concentrations of indoor formaldehyde ranged from 0.017 to 0.058 ppM; DuPont formaldehyde dosimiters and NIOSH tests were used and comparatively evaluated. A monthly variation in the overall average NIOSH results was evident and coincided with monthly variations in infiltration rates. The average radon concentration ranged from 0.3 to 2.2 picocuries/l and radon daughter concentration from 0.0007 to 0.0065 working levels. A monthly variation in overall average radon concentration was evident and also coincided with monthly variations in infiltration rates. Average interior relative humidities did not appear to differ significantly from house to house, and decreased rapidly from November to January. Additional research is recommended. 12 refs., 15 figs., 13 tabs.

40137 (MLEPS—111982) A study to determine contaminant build-up in houses. Phase 2. (MacLaren Engineers, Planners and Scientists Inc., Willowdale , Ontario (Canada)). Nov 1982. 76p. (CE—01727). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

As a followup to an earlier study of indoor air contaminants in Toronto houses during the heating season, a study was conducted on the buildup of contaminants during the summer months. Monitoring of formaldehyde, radon gas, and radon daughters was carried out and examined in relation to the air exchange rate and other meterological parameters. The main conclusions were as follows. Average infiltration rates obtained by tracer gas measurements for air conditioned houses ranged from 0.12 to 0.4 changes per hour; houses not air-conditioned had much higher rates. Average indoor formaldehyde concentrations for air-conditioned houses ranged from 0.019 to 0.136 ppM; non air-conditioned houses had very low concentrations. Vehicle exhaust from nearby roads would appear to be a factor influencing indoor and outdoor formaldehyde concentrations. Average radon concentration ranged from 0.37 to 2.26 pCi/l, and increased from winter values in all air-conditioned houses. A similar increase was observed with respect to radon daughters. The ratio between radon daughter concentration to potential concentration from the parent radon did not change significantly from winter to summer in those houses that were essentially closed year round. Average variations in formaldehyde and radon/radon daughters generally coincided with the average variations in infiltration rates for both summer and winter periods. Average interior relative humidities increased significantly from values observed in winter months. 13 refs., 10 figs., 6 tabs.

40138 (MRC—081987) Evaluation of CANMET'S Fossil Fuel Heating Program. Final report. (Marbeck Resource Consultants Ltd. (Canada)). Aug 1987. 142p. (MICROLOG—88-02038). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1. $0.34 CAN per page, $3.40 minimum; MF $10 CAN.

Since the first oil crisis of 1973 there have been substantial improvements in the combustion efficiency of Canadian residential heating equipment. Throughout this period, the Canada Centre of Mineral and Energy Technology (CANMET), not only initiated, but financially and technically supported, many of these improvements through its Fossil Fuel Heating Program. This study documents CANMET's research and technology transfer activities in residential heating systems and evaluates the impact of these activities on Canadian consumers and residential heating euqipment manufacturers as well as on the numerous government agencies, industry associations and consumer organizations which have a stake in new and improved residential heating technologies. The study concludes that the Fossil Fuel Heating Program provided very substantial economic benefits to Canadian consumers, heating equipment manufacturers and other non-manufacturing organizations. Total quantified benefits were estimated to be in 1987 present value terms at least $31.2 million, compared with program costs of $12.3 million. The key to the Program's overall influence, leadership and acceptance is its combination of technical capability and unbiased approach to the technologies involved. The study also proposes several means to further improve the Program's efficiency and effectiveness and recommends not only continuation of the Program, but also modest expansion of the resources allocated to it. Includes annotated bibliography. 11 figs., 4 tabs.

40139 (MU/ME—4) 1982-83 Building Technology Support Program. Restaurant sector. Final report. (Manitoba Univ., Winnipeg (Canada). Dept. of Mechanical Engineering). 31 Mar 1983. 15p. (CE—01524). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

This report outlines the activities of a program intended to support building technology for energy conservation in Canadian restaurants. Proposals for various research tasks (identified by title only), budgets, scheduling, subcontracting (if any), and progress to date are indicated. 2 refs., 5 tabs.

40140 (NP—8770292) Planning and construction of residential buildings meeting the requirements of climates and energy conservation - the Cologne-Braunsfeld community. Becker, F.W.; Wehmeier, N. (Technische Univ. Berlin (Germany, F.R.). Fachbereich 21 - Umwelttechnik). 1983. 174p. (In German). NTIS (US Sales Only), PC A08/MF A01. Order Number DE88770292/JAW.

The diploma thesis develops a structurally nature building project on the basis of theoretical schemes and the concrete designs resulting from them. Presenting various pictures and drawings the thesis informs about energy-saving buildings meeting the requirements of climates (demands, historical building designs, trends), town construction conditions (infrastructures, building activities, natural conditions), planning and projecting (existing and planned communities), aims (town construction concepts, plans), designs (models, types and styles of buildings, buildings located on slopes, row houses, chained houses), calculations (energy demand, housing space, calculation of quantities, cost-benefit analyses based on comparative evaluations of the annual costs of space heating). (HWJ).

40141 (NRC/BR—041982) Lighting energy conservation: simple analytic methods with time-lapse photography. Rea, M.S.; Jaekel, R.R. (National Research Council of Canada, Ottawa, Ontario. Div. of Building Research). Apr 1982. 33p. (CE—01458). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

Although time-lapse photography offers great potential for providing information on lighting energy conservation, it has been undeveloped because the quantity and detail of the data demand a great deal of time for analysis. Two simple analytic procedures are described to make time-lapse photography more useful: a sampling procedure for data reduction, and a formula for computing wasted lighting energy based upon occupancy and light usage. It is argued that poor utilization of lighting energy can be addressed with these procedures. 15 refs., 11 figs., 3 tabs.

40142 (NRC/BR—071982) Evaluation of Vacutainers for sampling of SF/sub 6//air mixture for air infiltration measurement. Tamura, G.T.; Evans, R.G. (National Research Council of Canada, Ottawa, Ontario. Div. of Building Research). Jul 1982. 18p. (CE—01551). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

Grab sampling of tracer gas/air mixture is a convenient method for conducting a survey of air infiltration rates in homes. Gas samples may be collected with a hypodermic needle and stored in Vacutainers. This technique is particularly suited when sulphur hexafluoride (SF/sub 6/) is used as a tracer gas, as only a small quantity of gas sample is required to measure its concentration with an ion capture detector/chromatograph. Because an extended delay is probable between collection and analysis of gas samples, storage

stability tests of SF/sub 6//air mixture in 20 ml Vacutainers were conducted. Samples can be stored for at least 21 days without significant changes in their concentrations. The gas sampling and analysis procedures are described in detail. 4 refs., 3 figs., 3 tabs.

40143 **(NRC/E—PASSIVE7) Review of the potential of passive solar strategies for office buildings.** Jones, L. (National Research Council of Canada, Ottawa, Ontario. Div. of Energy). Aug 1983. 122p. (CE—01554). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

The objectives of this study were to determine the potential for reducing energy use in office buildings by the adoptation of passive solar strategies and to identify and evaluate the potential of new technologies that could be developed. The study involved modelling various building configurations and passive strategies for an office building located in Ottawa using the DOE-2 energy analysis program. The intent of the study has been to evaluate the theoretical potential of the various passive options (such as daylighting, increasing south glazing, solar shading, and insulated shutter) to determine whether a particular option has a potentially worthwhile benefit before trying to solve any associated problems. The main conclusions reached during this study were that south facing glass has the potential for reducing energy consumption if there is complete thermal mixing and shading is used to minimize unwanted solar gains; "switchable" glazings are a particularly attractive technology to pursue; minimum envelope, deep-plan office buildings are not the most energy efficient solution; and the addition of an atrium increases energy consumption although an additonal semi-heated amenity area is provided. 24 refs., 47 figs., 18 tabs.

40144 **(OH/RD—87/224/K) Thermostat setback.** Jones, W.R. (Ontario Hydro Research Div., Toronto (Canada)). 15 Sep 1987. 6p. (MICROLOG—88-01786). Ontario Hydro Research Division, Editorial Section, 800 Kipling Ave., Toronto, Ont., Canada M8Z 5S4; $10.00 CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

Popular publications give a variety of figures for the expected savings from thermostat setback strategies. Recent literature was consulted to determine the proper level of such savings for the Ontario situation. Negative impacts of setback strategies were also investigated, such as increased morning power loads from switch-on of electric heaters. It is concluded that thermostat night setback yields modest savings (which are lower if the dwelling is better insulated), can diminish comfort, is inappropriate for heat pump systems, and significantly increases peak demand of the house. It is recommended that night setback no longer be actively promoted. 8 refs., 1 fig.

40145 **(OH/RD—87/239/K) Hot water system design for multi-residential buildings.** Olivares, T.C. (Ontario Hydro Research Div., Toronto (Canada)). 16 Dec 1987. 36p. (MICROLOG—88-02032). Ontario Hydro Research Division, Editorial Section, 800 Kipling Ave., Toronto, Ont., Canada M8Z 5S4; $10.00 CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

Monitoring of hot water consumption was done for five Ontario muli-residential buildings. The hot water consumption was analyzed with the purpose of developing a design criterion for future domestic hot water systems. It was found that hot water consumption during weekends, especially winter weekends, was significantly heavier than during other times. Two methods, involving the Cumulative and the Spielvogel design curves, were used to arrive at an optimal storage capacity and recovery rate combination. The computations were based on the winter weekend consumption. It was found that in most cases, the results derived from both methods were the same, and because of its simplicity, the use of the Cumulative design curve is recommended. The computer program used to calculate the design curves is provided in an appendix. 4 refs., 21 figs., 5 tabs.

40146 **(OH/RD—BETT8210) Effects of thermal upgrading on electrical wiring systems in houses. A research report. A state-of-the-art review of problems induced in residential electrical systems by energy conservation measures.** (Ontario Hydro Research Div., Toronto (Canada)). Oct 1982. 135p. (CE—01729). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

This study has been prepared to study the problems associated with house wiring and the installation of thermal insulation. A review of the literature was conducted and an annotated bibliography of 75 titles is included. Examination of this literature has led to the following overall conclusions. There is a lack of long term studies on the long term performance of older wiring at temperatures higher than 60 degrees C, and when surrounded by thermal insulation. Properly installed barriers can maintain recessed fixture surface temperatures below code requirements; however, installing these enclosures increases heat losses and risk of condensation. Adding insulation inside walls and ceilings without attention to the air/vapor barrier especially at electrical penetrations could focus moisture problems at these locations. Framing and insulation of service entrance panels can result in lower ambient temperature during the heating season, and can affect the operation of overcurrent protection. There is a lack of data on the effect of caulking compounds and sealants on electrical system components, and also on the effects of thermal upgrading measures on new electric system components such as PVC outlet boxes and nylon cable sheathing. New construction designs incorporating the double wall concept avoid problems with electrical penetrations by installing wiring and outlets between the air/vapor barrier and the interior finish. Mathematical modeling of electrical system components surrounded by thermal insulation shows good agreement with laboratory and field measurements. 58 refs.

40147 **(ORNL/TM—10392) Computer simulation of absorption heat pump using aqueous lithium bromide and ternary nitrate mixtures.** Ally, M.R. (Oak Ridge National Lab., TN (USA)). Jun 1988. Contract AC05-84OR21400. 35p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88013353/JAW.

A new aqueous ternary mixture consisting of 53 wt % $LiNO_3$, 28 wt % KNO_3, and 19 wt % $NaNO_3$is available for high-temperature heat pump applications. The pressure-composition-temperature and the specific enthalpy-concentration-temperature data in the form of correlated polynomial expressions are used in a computer program to simulate results of a temperature amplifier heat pump with LiBr/H_2O and ternary nitrate/H_2O mixtures as working fluids. In the absence of adequate thermophysical data for the fluids, the study serves as a best guess first approximation. The results show that the ternary nitrate mixture potentially has approximately a 10% advantage in COP and a 15% advantage in temperature lifts over aqueous LiBr at high temperatures. Ternary nitrates are hampered by crystallization at low waste heat temperatures and cannot operate competitively in the low lift and waste heat temperature regions. The potential performance advantage at high temperatures for the ternary nitrate mixture is sufficiently attractive to justify additional work to obtain adequate thermodynamic transport and corrosion data. 10 refs., 11 figs.

40148 **(PB—88-184908/XAB) Radon-reduction techniques for detached houses. Technical guidance (second edition).** Henschel, D.B. (Environmental Protection Agency, Research Triangle Park, NC (USA). Air and Energy Engineering Research Lab.). Jan 1988. 247p. (EPA—625/5-87/019). NTIS, PC A11/MF A01.

The document is intended for use by State officials, radon mitigation contractors, building contractors, concerned homeowners, and other persons as an aid in the selection, design, and operation of radon-reduction measurements for houses. It is the second edition of EPA's technical guidance for indoor radon-reduction techniques. This edition incorporates additional and updated information, reflecting new results and perspectives that have been obtained in this developing field since the first edition was published in June 1986. It is anticipated that future editions will be prepared, as additional experience is gained. New information is continually

becoming available through development and demonstration work funded by EPA and others, and through the practical application of these mitigation systems by private mitigators.

40149 (PM—121983) Systems view of energy efficiency in new housing. (Peat Marwick Ltd. (Canada)). Dec 1983. 59p. (CE—01553). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

The report examines the constraints and barriers to the achievement of energy efficiency in new housing in Canada and suggests methods by which such barriers may be removed. The potential roles of government are identified that could expedite the installation of energy saving measures in new homes. These include the dissemination of quantitative information on the performance and the financial advantages of various energy saving measures, and the provision of grants that reflect the societal benefits provided by the measures. Based partly on economic analysis and partly on a survey of builders and consumers, the study concluded that the key factors in people's decisions to install energy saving measures in new homes are financial. It also concludes that those measures that provide the largest financial savings to the home owners are already being installed to a greater extent than before and, while offering relatively few additional energy saving measures on their options' lists, most builders are highly responsive to any requests made for such options by the home buyers. 4 figs., 3 tabs.

40150 (SC—011983) Monitoring New Keewatin housing. Final report. (Scanda Consultants Ltd., Ottawa, Ontario (Canada)). Jan 1983. 87p. (CE—01506). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

In this study, four energy efficient houses in four Northwest Territories communities have been monitored in order to compare their performance to conventionally built houses in the same communities. The purpose of this study is to demonstrate the benefits and/or drawbacks of the demonstration house design relative to a conventional house. The demands for space heating, domestic hot water heating, lighting and appliances were monitored separately for twelve consecutive months. Fuel oil deliveries were also recorded as were outdoor daily temperatures. The houses were initially tested for airtightness, overnight building heat loss and moisture condensation in the walls and ceilings. The elevations of several points on the structure of each house were also established in order that any seasonal movement could be detected. The demonstration houses do not exhibit any market advantage, in terms of space heating demand, over the conventional houses. Furnace efficiency tests confirmed that the oil drip fire pot space heaters of the demonstration houses were much less efficient than the conventional houses, oil forced air furnaces. A number of suggestions are made as to how the space heater efficiency could be improved. The demonstration houses are equipped with an indoor temperature destratification system and with air-to-air heat exchangers to control humidity and maintain air quality without too much heat loss; these units are evaluated. Results of airtightness tests indicate that the demonstration houses are about twice as tight as the control houses. The sunporch, designed to act as a collector of solar gains, did not retain heat gained with any marked efficiency. The foundations of the houses appear to be relatively stable. 3 refs., 26 figs., 26 tabs.

40151 (STF—15A87026) Low tempearture heat in buildings. Hjorthol, E.M. (SINTEF, Trondheim (Norway)). Jun 1987. 32p. (In Norwegian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88753738/JAW.

The report presents a pre-project on low-temperature heating in buildings. The project focuses on the following approaches and subjects: Development of wall elements as heaters; technical/economic analysis on the location of the interior wall heaters; air heating in small houses; development of a central located heater for small houses; plant for the transfer of heat in glazed yards or the like; economic analysis of the total costs for the low-temperature heat in buildings with district heating. 13 drawings, 1 table.

40152 (STF—62A88004) Power and energy efficient dwellings. Preliminary study. Jacobsen, T.; Raaen, H.; Hestnes, A.G. (SINTEF, Trondheim (Norway)). Feb 1988. 20p. (In Norwegian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88753742/JAW.

The report describes the development of a concept for the evaluation of energy conservation measures to decrease the power- and energy demand for various heating systems, lighting, and households. The final concept concerns a well-insulated dwelling designed with a glazed zone in the middle part of it, and the heating system combines a solar water heating system and an exhaust heat pump. The total power demand is about 9000 kWh/year. 11 drawings, 4 tables.

40153 (STU—86-3551) Unconventional processes for heat pumping. Ljung, L. (Swedish National Board for Technical Development, Stockholm). Jan 1987. 45p. (In Swedish). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88753754/JAW.

A number of heat pump processes are studied where neither the conventional evaporation process nor the absorption process is carried out. Processes considered are: - Gas processes e.g. Joule or Stirling cycles. The potentially high coefficient of performance is of advantage together with the possibility of using air as the working substance and also as heat source. However, in practice the attainable coefficients of performance are low. - Thermo-electric heat pumping (Peltier effect) is of interest, on one hand as electric energy is directly utilized as driving power, on the other as the heat pump has no moving parts. The maximally coefficients of performance attainable are however low today and the cost of components high. - Magnetic heat pumping with gadolinium as the working substance. Performance and costs are however unfavourable. The report presents in addition some ideas of unconventional design principles concerning heat pumps using gases as working substance, and some proposals for hypothetic principles of heat pumping. It is concluded that the evaporation process, despite the great number of alternatives, for a near period will in all be the most favourable process. (O.S.). With 16 refs.

40154 (SV-UL—1987-28) Exterior air source heat pump for electrically heated houses. Performance and system functioning for kryotherm VPLL and VPLV in laboratory and in practical operation. Sjoeberg, M. (Swedish State Power Board, Aelvkarleby). 5 May 1987. 37p. (In Swedish). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88753758/JAW.

The Aelvkarleby laboratory has evaluated results of one years operation of heat pumps of Kryotherm VPLL and VPLV type (exterior air/air and exterior air/water) installed in five houses, previously electrically heated. In one house also more detailed measurements were done in order to investigate effectiveness of the heat distribution and of joint operation with existing electric radiators. Furthermore, one heat pump VPLV26 was tested at the laboratory. The operating results show differences in energy saving between the houses. The conservation figures are estimated to between 9.7 and minus 4.0 MWh for the test period, being between 5 and 12 months. Despite the fact that incomplete data from the tests brought about the measured conservation figures to be very approximate for some of the houses, it is quite obvious that the mean saving is far to low. One explanation of the feeble result would be the frequent interuptions of operation in some cases. Furthermore, the heat distribution turned out to be less efficient. An improved distribution would create a more uniform indoor climate and would noticibly increase the degree of energy covering and operating economy. The effectiveness of the heat distribution is influenced by how heat is supplied to the rooms and not by type of heat pump as such. The heat pump that was tested in the laboratory did not fulfil the manufacturer's performance statements. Defrosting problems further deteriorated the results. By alterating from differential temperature control to fan current control the defrosting functioning was considerably improved. (G.B.).

40155 **(SV-US—1987-27) Gas heating - Skogshoejden.** Berggren, B. (Swedish State Power Board, Vaellingby). 14 Apr 1987. 17p. (In Swedish). NTIS (US Sales Only), PC A03. Order Number DE88753761/JAW.

The report deals with domestic heating with gas as an alternative for electrical heating in a planned housing area in Trollhaettan, Sweden. The basic idea has been the use of landfill gas or LPG. All alternatives will be designed to provide a future connection to a natural gas network. Major conclusions: -Landfill gas is not interesting in this case due to doubts about emissions together with the high gas price offered. -LPG and natural gas gives approx the same cost per kWh as electricity when only the appartment houses are supplied with gas. The installation cost in the single family houses seem to be too large to give a good economy. By introducing the latest technology from abroad and some technological development there might be an interest for domestic heating with gas in single family dwellings too.

40156 **(UNIES—MG11456) An evaluation of the effectiveness of air leakage sealing, Ener-Corp Management Ltd.** (UNIES Ltd., Winnipeg, Manitoba (Canada)). 1983. 50p. (CE—01515). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

A field study was carried out to evaluate the effectiveness of the sealing techniques for reducing air infiltration in houses. Tests were performed on single detached houses in Manitoba. The sample group consisted of 56 conventionally-constructed houses of varying size, style, occupancy and airtightness, and 26 nonstandard structures of smaller but identical size and age. Results show the median reduction in airtightness of the conventional structures, defined using the Equivalent Leakage Area at 10 Pascals (ELA/sub 10/), was 31.6%, with significant variations occurring both between individual houses and between different types of construction. The median reduction of the nonstandard houses was 42.5%, again with significant variations. An estimate was made of the naturally-occurring air infiltration rates for all the test houses. This analysis indicated that the sealing produced a median reduction in the infiltration rate of 32.8% for the conventional houses and 46.1% for the nonstandard ones. To relate the benefits of sealing in terms of its impact upon the space heating load, the data were used in conjuction with standardized house descriptions to simulate five different styles of houses using the HOTCAN energy analysis program. This analysis indicated that air leakage sealing would produce reductions in the space heating load (and bill) for most conventionally insulated houses averaging 10% to 15%. The results of this study are likely representative of houses constructed only in Manitoba and possibly Saskatchewan and Alberta. 3 refs., 9 figs., 11 tabs.

40157 **(VTT-TIED—814) Grading of building maintenance. Indoor air.** Lounela, T.; Rautiainen, A. (Valtion Teknillinen Tutkimuskeskus, Espoo (Finland)). Jan 1988. 89p. (In Finnish). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88753765/JAW.

The report is a part of the study dealing with building maintenance. The aim of the study is to give the principles for the quality classification and write a draft quality classification for the main tasks of building maintenance. The correlation between quality and maintenance cost has been considered. This study adapts the principles of grading of building maintenance to indoor air. The grading has four classes: 1. Good 2. Satisfactory 3. To be remedied 4. Downfall. The grading criteria are thermal comfort and healthiness. The grades for thermal comfort are fixed with PMV-and PPD-indexes of ISO standard 7730. The indoor air grading developed in the study has been applied in a test building, primary school (completed 1982). The measuring of indoor air indicates too littele air humidity, RH <20%, which corresponds to grade 4. The CO/sub 2/-content is less than 0.10% (grade 2). Only thermal comfort is first grade. The indoor air of the test building has been optimized by means of running the ventilation fan of classrooms and administration rooms at half-effect. Also the time schedule of ventilation has been changed. The air humidity grade 3 (RH >20%) and cleanness grade 3 (CO/sub 2/-content <0.15%) have been attained, when outdoor temperature was -10 to -30 deg C. The correlation between quality grades and energy consumption has been theoretically calculated in the test building. Both theory and tests prove that energy conservation is possible while improving indoor air quality if the use of ventilation equipment is not optimal. A curved correlation can be calculated between indoor air quality and energy consumption of optimally used ventilation equipment. In the test building it has been possible to relieve the nuisance of too dry indoor climate while reducing energy consumption from 38.0 to 32.6 kWh/m"3. The total yearly energy saving was 148 MWh corresponding to 20000 FIM.

40158 **(VTT-TIED—821) Estimation of the maintenance costs of a school building to be renovated.** Saarenpaene, J.; Hekkanen, M. (Valtion Teknillinen Tutkimuskeskus, Espoo (Finland)). Jan 1988. 231p. (In Finnish). NTIS (US Sales Only), PC A11. Order Number DE88753767/JAW.

The objective of the study was to create a maintenance cost estimation to support decision-making in the planning stage of a renovation project. The study comprises the development of the procedure for school buildings to be renovated. The study also presents the special characteristics for office buildings and for establishments of social welfare and health care. The testing of the estimation procedure was limited to school buildings only. The maintenance cost estimation procedure was created on the basis of literature and by examining two schools renovated in the early 1980's. The calculatory estimation procedure is based on the determining and pricing of essential maintenance inputs. As a result of repairs, the total maintenance costs of a school building usually rise. According to the study, the heat energy consumption of a school building increases after renovation if the repairs do not involve energy saving measures. Likewise, the power consumption of a school building tends to rise during the repairs. The administrative costs are usually not affected by renovation. As a rule, renovation decreases the amount of manual work for the maintenance personnel and respectively increases the amount of work needed in operating various control devices. Energy tariffs for heating and electric power as well as water and wastewater duties show great regional differences. In estimating the maintenance costs at the planning stage, the pricing should be based on local unit prices. The maintenance cost estimation procedure now developed is suitable primarily for school buildings to be renovated, providing at the planning stage a tool for estimating their maintenance costs. The procedure gives results at a correct level for various maintenance tasks even for a renovation object involving change of use as has been established by testing. In principle, the maintenance cost estimation procedure developed is also applicable to new constructin.

40159 **(VTT-TIED—824) Ventilation units in each flat in a residential building.** Heikkinen, J. (Valtion Teknillinen Tutkimuskeskus, Espoo (Finland)). Jan 1988. 102p. (In Finnish). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88753768/JAW.

A mechanical supply and exhaust ventilation system with ventilation units in every dwelling has been monitored during two years period. The house has 35 dwellings in sevn stories. The central exhaust system is equipped with a fan which is to provide the basic exhaust air flow rate. The exhaust fan of the ventilation unit in the kitchen is used to force the exhaust air flow rate from the kitchen hood when needed. The residents forced the kitchen ventilation 50 minutes per day in the mean. There were great differences in times of forcing as well as in duration of forcing. Individual control of kitchen ventilation seems to be necessary. The ai flow rates in the ventilation system were stable irrespective of weather conditions or use of forcing because of high pressure in the ducts. The house was airtight enough, internally and externally, for the ventilation system to keep a slightly lower pressure in dwellings than in the ambient air in most weather conditions. This is essential to prevent moisture damages and inconvenience of moisture between window glasses. The air velocity in the occupied zone was well below comfort limits. Some residents still feel draught. The minimum temperature of supply air to the living-rooms in winter was about 10 deg C. The hea transfer in the supply air ducts was able to raise the supply air temperature considerably as well as to smooth the supply air temperature variations. About half of the exhaust air energy was recovered in the heat exchanger of the ventilation unit. The suitable service interval of the ventilation units is six months but even one year service interval seems to be reasonable. The air filters can be washed in a machine at leat 3 to 4 times.

40160 **(VTT-TIED—833) Winter shelters in Finland. Preliminary investigation.** Rantamaeki, J.; Kivijakola, P. (Valtion Teknillinen Tutkimuskeskus, Espoo (Finland)). Feb 1988. 34p. (In Finnish). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88753771/JAW.

The preliminary study of winter shelters is one part of the Kilpisjaervi test building project. Efforts were made to clarify the usability of winter shelters and to seek the factors influencing the use of winter shelters on building sites. The study presented also research topics relating to winter shelters. The acquisition of winter shelter to the building site is now primarily a question of cost. It is acquired if its use is economically profitable. According to most of the interviewed the use of winter shelter is profitable in winter building. It is even national-economically profitable particularly if it can reduce the number of the so-called frost days on the building site. The most general use of winter shelter on the building site is for protection against snow and frost. It enables work even in severe climatic conditions and ensures thus for its part that the work is on schedule independent of the weather. It protects against snow, frost, wind, rain and sun. On building site winter shelter is used as work and stock shelter. When used in a correct way, winter shelter saves building materials, shortens work time, improves the quality of the final result, makes work more meaningful and improves order and work safety on the building site. Research should be directed at the estimation of the economy of winter shelters, their product development, study of the accident reducing effect of winter shelters and work conditions when winter shelters and heaters are used.

40161 **(VTT-TIED—841) Future of information technology in construction.** Koskela, L.; Silen, P.; Alasalmi, M. (Valtion Teknillinen Tutkimuskeskus, Espoo (Finland)). Mar 1988. 200p. (In Finnish). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88753773/JAW.

The aim of the study is to give an outlook over the applicability of information technology to the construction in the 1990s as well as change and development requirements related to it. On the other hand the benefit of the information technology is partly depending on the cooperation within the whole construction sector in order to develop necessary infrastructure for information processing, data transfer formats and working practices within the projects. Because the international competitive capacity of the building industry is in part depending on this infrastructure for information processing, in many countries national development work has been started for the computerization of the construction field. Both the factors mentioned above, competition between building firms and on the other hand, securing international competition by means of national projects, will accelerate the development: of information technology in the building sector and indirectly also the development of building technology.

40162 **Parametric modelling of temporal variations in radon concentrations in homes.** Revzan, K.L.; Turk, B.H.; Harrison, J.; Nero, A.V.; Sextro, R.G. (Lawrence Berkeley Lab., 90-3058, 1 Cyclotron Rd., Berkeley, CA (US)). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* **35**: No. 1, 550-555(Feb 1988). (CONF-871006—).

From 34. nuclear science symposium and 19. nuclear power systems symposium; San Francisco, CA, USA (21 Oct 1987).

The /sup 222/Rn (radon) concentrations in the living area, the basement, and the underlying soil of a New Jersey home have been measured at half-hour intervals over the course of a year, as have indoor and outdoor temperatures, wind speed and direction, indoor-outdoor and basement-subslab pressures; in addition, periods of furnace operation have been logged. The authors develop a preliminary version of a mathematical model which demonstrates the dependence of the radon concentrations on the environmental variables and the extent of furnace use, with the purposes of improving our ability to predict occurrences of elevated concentrations in general, increasing the usefulness of short-term measurements in particular, and assisting us in devising remedial measures. They discuss the possibility of determining the model parameters from knowledge or measurement of geological and structural characteristics.

40163 **(ORNL/tr—88/10) Current status and trends in compressor development: 3.2, Hermetic motor: 3.21, Direct current.** Serizawa, Yukio; Iizuka, Kenichi; Senoh, Masaharu; Nakamura, Youzoh; Kanoh, Minoru; Endoh, Tunehiro. Translated from *Reito ;* **62**: No. 721, 54-59(Nov 1987). Contract AC05-84OR21400. 17p. NTIS, PC A03. Order Number DE88009246/JAW.

Inverter type air conditioners have recently become significantly more widespread because of the need for energy conservation and the desire to use room space efficiently. The type of air conditioner controls the capacity of the unit by changing the drive speed of the compressor. However, energy loss occurs at the inverter section of the conventional inverter air conditioner. Furthermore, energy conservation is not sufficient in a combination of the compressor with a conventional inductive motor and the inverter. Hitachi has developed a compressor utilizing a high efficiency brushless motor that uses a permanent magnet as the rotor. This new development is installed on the product named "DC inverter air conditioner." The present paper describes the performances, motor section, structures, and inverter control sections of the compressor specifically made for the Hitachi DC inverter air conditioner.

40164 **Deterrents to energy conservation investment in public housing.** Mills, E.; Ritschard, R.L.; Goldman, C.A. (Lawrence Berkeley Lab., Applied Science Div., Energy Analysis Program, Univ. of California, Berkeley, CA (US)). *Energy Systems and Policy;* **11**: No. 3, 169-184(1987).

In an effort to reduce rising energy costs, the Department of Housing and Urban Development (HUD) has strongly urged local public housing authorities (PHAs) to improve the energy efficiency of their building stock. In this study, the authors examine the relative impact on HUD and PHAs of four retrofit financing strategies used by two local housing authorities. They find that the existing Performance Funding System (PFS) regulations tend to discourage PHAs from actively pursuing cost-effective investments that improve the energy efficiency of their housing projects. The authors' results indicate that HUD policies distribute the dollar savings from conservation retrofits in such a way that HUD receives substantial benefits, while local public housing authorities get few benefits. In fact, PHAs can lose money, even in cases where there are significant energy savings and payback periods of less than three years. The authors tested several alternatives to the current regulations and found that the best way to encourage PHAs to conserve is for HUD to reimburse them for new maintenance and capital costs of the conservation retrofits.

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REFER ALSO TO CITATION(S) 39153, 39555, 40230, 40632, 40765, 42492, 42492

40165 **(CU—TP3759) The future role of the automobile in Canada.** Khan, A.M. (Carleton Univ., Ottawa, Ontario (Canada)). Mar 1982. 106p. (In English and French). (CE—01433). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

This paper describes the future role of the automobile from an intercity transportation perspective in multimodal contexts; it identifies courses of action open to Transport Canada officials in support of the suggested role. Discussed here is the automobile's multifaceted role, focussing mainly on its use as a mode of door-to-door travel for short trips, a feeder as well as an adjunct to public modes, a means of avoiding excessible public expenditure in highly subsidized public modes (e.g., rail), and a means for providing basic mobility in regional travel contexts. This study goes beyond the 1979 Transport Canada report with the same title by recommending courses of action that might assist officials in formulating policy, planning and other endeavours. At the outset, updated information is provided on the current status and future outlook of selected important factors that affect the future transportation role of the automobile. Against this background, the relevance of major findings of the 1979 automobile report are reviewed and gaps in knowledge identified. On the basis of this information, a future role

for the automobile is discussed, with appropriate courses of action recommended. These recommendations and their institutional/program implications are addressed to Transport Canada in the areas of strategic planning and policy, energy planning, safety and coordination of actions/programs with other federal government departments and provincial governments. 48 refs., 8 tabs.

40166 **(DE—031983) Continued development of the on-board data acquisition systems.** (Davis Engineering Ltd., Ottawa, Ontario (Canada)). Mar 1983. 34p. (CE—01509). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

Some concern has been expressed about the absolute accuracy of the on-board data acquisition systems (DAS) for measuring fuel consumption. The systems are currently being used to gather fuel consumption data under a wide range of operational conditions, and as a result it is important to determine if any operational limitations exist. In some recent preliminary comparisons, it was found that vapors existing at excessively high fuel temperatures caused high fuel consumption readings to be indicated by the DAS. It was deemed necessary to undertake a study under controlled conditions to determine at what fuel temperatures errors are significant and to what extent corrective measures could be applied. The objectives of the project were to analyse existing comparisons obtained from dynamometer tests to obtain preliminary assessments of potential errors, to implement dynamometer testing using two different fuel consumption measurement devices and compare the results to DAS results (the testing to be carried out at various ambient and fuel inlet temperatures with and without the use of devices to reduce fuel vaporization), and to analyse the results to determine at what temperature fuel vaporization causes significant errors in the fuel consumption data and evaluate the use of devices which reduce fuel vaporization. It was found that fuel consumption rates, as indicated by the DAS, can be in error if the initial boiling point temperature of the fuel is exceeded by the vapor present, otherwise (at low temperatures) DAS readings were in good agreement with a gravimetric fuel consumption measuring system. The DAS operated satisfactorily at elevated fuel temperatures if the fuel system is free of local hot spots and if a heat exchanger of sufficient capacity is installed in the fuel line to reduce fuel vapors. 7 figs., 9 tabs.

40167 **(ISL/CR—4352) Canadians evaluate the Fuel Consumption Guide. A qualitative research report.** (International Surveys Ltd., Toronto, Ontario (Canada). Customer Research Div.). Feb 1983. 90p. (CE—01436). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

For the last few years, Transport Canada has produced and distributed the Fuel Consumption Guide, a booklet consisting of an up-to-date compilation of fuel consumption ratings of the latest model cars together with a brief review of other factors affecting fuel consumption. In view of certain concerns with respect to Canadian reactions to the Guide, it was therefore decided to evaluate the 1983 edition. This report presents the results of the first phase of the research program, the qualitative evaluation. It consisted of a series of ten group discussions across the country. In all cases participants were current drivers who claimed a probable or definite intention to buy a 1983 car some time this year, who had not participated in any other such discussion in the last six months, and who were unknown to any other participant. The research was designed with the following objectives: to provide an additional dimension to the quantitative evaluation, to enhance and expand the depth of understanding of this subsequent evaluation, and to evaluate the proposed questionnaire for the quantitative study, its appropriateness, its comprehensiveness, its terminology. With respect of the former point, the metric format of the tables was a particular focus of interest. The results of this questionnaire may provide a preview to the results to be obtained from the full quantitative study. These results are presented with a warning that due caution be exercised in interpreting them and are not discussed in the body of this report; its focus on the questionnaire is directed exclusively at the recommendations for questionnaire modifications arising from the discussion. 1 tab.

40168 **(JAPA—TP4946E) Assessment of energy conservation options for freight and passenger transportation.** (Parviainen (Jouko A.) and Associates, Oakville, Ontario (Canada)). Oct 1983. 242p. (CE—01529). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

The objectives of this study were to identify all known and emerging energy conservation measures, to assess the cost-effectiveness of each measure and rank order the measures within each mode, and to summarize findings in a matrix format. The results from the literature search, consultation and the preliminary assessment are summarized in matrix format in an appendix. This contains selected details for over 240 conservation measures and sub-measures, and includes target specification, level of application, potential energy savings, time required to implement, constraints to implementation and an indication of priority. The results of the subsequent evaluation of roughly one quarter of the measures, are presented on 2-3 page profile sheets. These contain a description of one specific application and the related assumptions for each selected measure, estimated fuel consumption change and other impacts, and a list of complementary measures. Relative rankings of measures within each mode are developed and sample packages of complementary incentive/disincentive measures presented. The report also discusses selected regulatory and legislative issues and how different fuel price scenarios might affect the implementation of energy conservation measures in the transportation sector. Finally, a brief section is included to summarize the current situation and to highlight the prime research and development opportunities identified for each of the modes during the evaluation. An overall conclusion is that the opportunities for accelerating the implementation of energy conservation measures appear excellent, particularly in the passenger sector. 167 refs., 1 fig., 11 tabs.

40169 **(OTC—1987) Trucksave economy challenge, 1987: vehicle and performance data results.** (Ontario Ministry of Transportation and Communications, Ottawa (Canada)). 1987. 28p. (MICROLOG—88-02121). Ontario Ministry of Transportation and Communications. Transportation Technology and Energy Branch, 1201 Wilson Ave., Downsview, Ont., Canada M3M 1J8; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

This report provides the results of competitions held to determine the best fuel economy performance by trucks and their drivers. Competitors, driving tractor-trailers of various types (e.g. van, flatbed, tanker) classed by weight, traveled specified routes in Ontario, and, in a separate contest, an interprovincial route. Participants were ranked on the basis of liters of fuel consumed per metric tonne of gross vehicle weight per 100 kilometers. A time limit was enforced to prevent dangerously slow driving, and anyone not maintaining a specified speed was penalized. Results are presented for the various vehicle and weight classes; data also presented include vehicle characteristics and miles per gallon (adjusted and unadjusted). Included is a separate document entitled "The Interprovincial Challenge, 1987" which contains specific data for the province of Manitoba.

40170 **(OTC—031986) Employer-sponsored vanpooling in Ontario. An inventory '86.** Gallant, L. (Ontario Ministry of Transportation and Communications, Ottawa (Canada)). Mar 1986. 60p. (MICROLOG—88-01830). Transportation Energy Management Program (TEMP), Central Building, Rm. 324, Ontario Ministry of Transportation and Communications, 1201 Wilson Ave., Downsview, Ont., Canada M3M 1J8; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

To determine the extent of vanpooling's diversity among employer-sponsored programs, a survey of Ontario's vanpool administrators has been conducted. In all, 12 companies operating a total of 151 vanpools responded to the survey. It was found that the companies offering vanpooling are very satisfied with their programs. As well as reducing parking congestion or easing relocation impact, many have realized the additional benefits of improved employee

morale, increased productivity, and favourable publicity. The topics surveyed in this report are: program status, company features, company support, incentives, operational features, van specifications and operations, maintenance, operating costs, insurance coverage and costs, and fares. The inventory serves as source material for a company considering the implementation of a vanpool program and provides current operators with the opportunity to exchange information about their programs. 4 figs.

40171 **(OTC—TTE8503) Mandate, objectives and networking contacts.** Stermac, A.G. (Ontario Ministry of Transportation and Communications, Ottawa (Canada)). May 1985. 59p. (MICROLOG—88-02095). Ontario Ministry of Transportation and Communications. Transportation Technology and Energy Branch, 1201 Wilson Ave., Downsview, Ont., Canada M3M 1J8; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

The Ontario Technology and Energy Branch has the mandate to conduct and promote research, development and application of transportation and energy technologies and systems which improve the efficiency and effectiveness of Ontario transportation systems, support the transportation industry, and foster economic growth. This directory gives names, departments, titles, and phone numbers of personnel and consultants associated with various offices of this branch, and also outlines the mandates and research objectives of these offices. The offices are concerned with automotive technology and systems, transportation energy, rail technology and systems, transit control technology and systems, and administration and technical publishing. Research objectives involve areas such as alternate fuels, vehicle testing, transportation energy efficiency and conservation, public transit systems, car pooling, and fuel economy.

40172 **(PB—88-187943/XAB) Modeling and simulating the macroeconomic effects of alternative transportation investment strategies. Final report (revised).** Mahdi, S.I. (Benedict Coll., Columbia, SC (USA)). Mar 1988. 103p. NTIS, PC A06/MF A01.

The purpose of the study was to model and simulate the impact of alternative DOT expenditures by mode on employment and real disposable income. Using a 490 Sector Input/Output Model of the United States, conjoined with a structural model of the United States, the study simulated short-term, intermediate-term, as well as dynamic disequilibrium path projections of the effects of DOT expenditures by mode when financed by general funds or user-supported fees over each year for a ten-year period. The study provides policymakers and planners at DOT with a means of anticipating the short-term employment-output consequences of alternative expenditure strategies using a standard demand-side methodology.

40173 **(PB—88-199591/XAB) Hot-mix recycling: VTI experiments during the years 1982-1986.** Wagberg, L.G. (Statens Vaeg- och Trafikinstitut, Linkoeping (Sweden)). 1988. 60p. (In Swedish). (VTI/MEDDELANDE—531). NTIS, PC E04/MF A01.

Increasing bitumen prices during the period 1973 to 1984/85 has led to an increasing interest in the recycling of bituminous paving materials. New techniques and equipments were developed that to some extent can compete with conventional methods for maintenance of bituminous pavements in terms of cost and quality. The reclaimed pavement material mainly consists of: portions of pavement materials excavated in conjunction with road works, etc; and materials removed by means of cold milling. So far, production of hot-mixed asphalt concrete utilizing the recycling technique has been relatively limited in Sweden. A total of 150,000 tons has been manufactured during the period 1981-1985.

40174 **(SAND—88-0877) Development of a man-portable control unit for a teleoperated land vehicle.** McGovern, D.E.; Spires, S.V. (Sandia National Labs., Albuquerque, NM (USA)). May 1988. Contract AC04-76DP00789. 16p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88011280/JAW.

A man-portable conrtrol unit has been designed and fabricated to support teleoperation of a land vehicle. The basic contol unit is configured to include the capabilities of mobile platform control, platform location and status display, sensor contol and output display, and weapons contol, if so desired. When the platform is being driven to a new location, the operator is able to control the platform through basic steering, braking and speed commands, obstacle recognition and avoidance, maneuvering in constricted space, and navigation with visual cues and simple dead-reckoning inputs from the vehicle. While the platform is on station, the human operator is able to perform the functions of surveillance, target recognition, target tracking, and weapons or designator control. A fully software-driven system has been configured to meet these requirements. All controls and vehicle signals are processed by an onboard microprocessor allowing the system to be easily reconfigured. Video information is provided through a set of three CCTV monitors. Graphics and alphanumeric data are provided on a flat panel dislay. Push buttons, keypad, trackball, throttle lever, and a steering yoke accept operator input. A video cueing system is included to allow automatic processing of the platform video for motion detection surveillance operations. The man-portable control unit was developed for application to the Teleoperated Mobile All-Purpose Platform (TMAP) project supported by the US Army Missile Command (MICOM). The control unit has been integrated with the MICOM vehicle system and with a vehicle system at Sandia National Labs. 2 refs., 7 figs.

40175 **(TC/RU—TMRU8304) Consumer response to the 1983 Fuel Consumption Guide.** Jonah, B.A.; Dawson, N.E. (Transport Canada, Ottawa, Ontario. Road Users Div.). Dec 1983. 67p. (CE—01434). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

In order to assess consumer response to the 1983 edition of Transport Canada's Fuel Consumption Guide which provides consumers with fuel consumption ratings for most new cars sold that year, 1,393 people who had requested the Guide and received it were interviewed by telephone. About 25% said that they never received the Guide in the mail even a month after it was sent. Of those receiving it, 13% had not bothered to look at it prior to the interview while another 40% had only glanced at it. While the main reason for requesting the Guide was to compare the fuel consumption ratings of new cars, it appears that as many as 50% of the consumers are looking up the ratings of their current vehicles, which is a misuse of the publication. While relatively few problems with the Guide were offered spontaneously to the interviewer, 25% of the respondents reported having difficulty with the metric units when asked directly about them. The most common suggestion offered for improving the Guide was to add miles per gallon to the tables. Most people felt that it would be a good idea to display the ratings by vehicle size. About a third said that they would be unable to use the Guide without the metric conversion table. When asked about metric conversion in general, 48% were in favor while 38% were opposed, and the rest were neutral. Overall, 90% of those people receiving the Guide were satisfied with it. It is encouraging to note that 60% of those receiving the Guide felt that it influenced their decision to purchase a fuel efficient vehicle. Several recommendations are offered to improve the distribution of the Guide and the comprehension of the information that is contained within it. 3 refs., 23 tabs.

40176 (TC/TDC—TP4428E, pp 113-118) **The Federal Energy R & D Program.** Johnson, W.F. 15 Mar 1983. Transport Canada, Montreal, Quebec. Transportation Development Centre. (CE—01644; CONF-8303232—).

From Transportation development centre railway energy seminar; Montreal, Canada (15 Mar 1983).

The Transport Canada energy research and development program concentrates on the road transport mode, however, a number of rail-related programs are underway and described in this report. A conservation program aims to increase fuel efficiency and to investigate rail electrification under Canadian conditions. Another program has been under taken to develop timely, economic and safe alternatives to conventional oil base fuels for railway applications. A transport of hazardous commodities program intends to develop alternatives for transport of hazardous fuels by rail. A strategic rail energy research and development plan is also being pre-

pared, in order to arrive at an ordering of energy related options for railway propulsion in Canada during the short, medium and long term.

40177 (TC/TDC—TP4428E, pp 13-24) **Energy conservation at CP Rail. A glance back and a look ahead.** Hollman, D.R. (Canadian Pacific Rail). 15 Mar 1983. Transport Canada, Montreal, Quebec. Transportation Development Centre. (CE—01644; CONF-8303232—).

From Transportation development centre railway energy seminar; Montreal, Canada (15 Mar 1983).

This paper addresses some practices that Canadian Pacific Rail is undertaking to conserve energy. Past accomplishments resulting in significant savings have been reduced idling of locomotives (except during cold weather when engines are kept running to avoid start-up problems at low temperatures) which saved about 1.4 million gallons of fuel a year, and better fuelling practices to reduce spillage and leakage, resulting in a spillage reduction from 1.3% to 0.17%, saving 2 million gallons of fuel a year. A more recent possibility mentioned in this report is using cruise controls on trains to optimize power settings for lowest fuel consumption. Considerable detail is expended on describing a system for ensuring fuel security, i.e. to make sure that fuel is properly inventoried, that fuel ordered is actually received, that no fuel is being leaked or stolen or being returned in tank cars, and to determine what portion of fuel is used for heating, if any. This procedure includes strict control of receipts and computerized calculation and accounting. Finally, the report describes efforts to conserve energy used in operating railway buildings. Most of these were constructed in the early 1900s and are highly inefficient users of energy for heating, and relatively simple measures such as proper sizing of boilers and heating equipment, new electric lighting, and smaller, more efficient shop design can achieve significant energy and cost savings.

40178 (TC/TDC—TP4428E, pp 1-11) **On the energy question at CN Railways.** Cyr, W.H. (Canadian National). 15 Mar 1983. Transport Canada, Montreal, Quebec. Transportation Development Centre. (CE—01644; CONF-8303232—).

From Transportation development centre railway energy seminar; Montreal, Canada (15 Mar 1983).

This paper discusses the two main concerns of Canadian National Railways regarding energy: energy supplies and costs. While supply of oil, including reserves, is sufficiently greater than demand so as to cause no worries, cost of fuel is another matter, particularly of locomotive fuel, which can reach 15% of total railway operating costs. An analysis of the dynamics of trains presented in this paper shows large possible reduction in fuel consumption with reduction in speed. Other fuel economies are possible such as using lower cost fuel blends, shutting down locomotives when not in use, and more efficient train operation, with estimated 10% reduction possible with specialized training of crews. Other energy savings are possible within the railway system, such as increasing the energy efficiency of railway buildings and stationary equipment. 3 figs.

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REFER ALSO TO CITATION(S) 39089, 39097, 39106, 39328, 39471, 39597, 40001, 40013, 40118, 40173, 40633

40179 (BNL—52068-Vol.2, pp 349-358) **Condensing heat exchanger for heat recovery from flue gases.** Grehier, A.; Rojey, A. (Institut Francais du Petrole (France)). Apr 1987. NTIS, PC A10/MF A01. Order Number DE88005230/JAW. (GRI—87/0091.2; CONF-8704247—Vol.2).

From International symposium on condensing heat exchangers; Columbus, OH, USA (14 Apr 1987).

Increasing the efficiency of industrial processes and heating installations requires lowering exhaust temperature of effluents to levels where condensation occurs of products issuing from processes or from combustion. To the savings of sensible heat, condensing recovery adds the savings resulting from the latent heat of condensed products. The design and construction of a heat exchanger whose modular assembly and chemical resistance make it readily adaptable to the problems raised by users are discussed. The heat exchanger is built by stacking plates, made by the injection of polymers and equipped with notched crossbraces forming the spaces required for the passage of fluids, so that countercurrent or crosscurrent heat exchanges can be achieved. The relative positioning of the plates is ensured by recessing lugs providing leakproofness where the tightening tie bars of the stack pass through. This arrangement, which makes it unnecessary to use large lateral brackets to hold the stack together mechanically, results in considerable lightening of the heat exchanger. A prototype heat exchanger with a heat-exchange surface equal to 215 ft^2 has been built according to this design and has been used as an air preheater for heat recovery from the flue gases of a 1.6-MW furnace. A second operation in the field of residential heating applications has been undertaken with Gaz de France concerning the construction of a dehumidifying heat exchanger having an exchange surface of about 355 ft^2. This heat exchanger will be positioned to process flue gases of a condensing boiler. The development of the condensing heat exchanger is described.

40180 (CEDSI—011983) **Potential for energy conservation in the food and beverage industries through anaerobic digestion of wastes to methane.** (Canadian Energy Development Systems International Corp., Ottawa, Ontario). Jan 1983. 177p. (CE—01419). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

The Canadian food and beverage industry is the fourth largest consumer of energy among manufacturers. An area of energy use which has received little attention in the past is that of waste treatment. Conventional aerobic treatment systems tend to be energy-intensive, unlike new high-rate anaerobic processes which often have better balances because they produce recoverable methane that can be used for fuel. For these reasons, anaerobic systems may be attractive to food and beverage industries seeking an economical means of waste treatment. A number of factors will determine whether anaerobic treatment is a feasible option for a given plant. Chief among these are waste strength, waste temperature, waste flow rate, consistent production of waste, and need for and cost of treatment. This study attempted to determine for what proportion of Canadian food and beverage companies anaerobic treatment is likely to be a feasible option in the near to middle term. It was found that the general plant effluents of several industries appear in many cases to be economically treatable by anaerobic processes, and practical considerations involved in methane end-use were briefly considered. A number of barriers to the application of anaerobic technology were revealed, including high capital costs, the dilution of high strength effluents, misconception about anaerobic processes, ignorance of the state of the art and the ambiguities in regulations and standards concerning biogas. 108 refs., 22 figs., 45 tabs.

40181 (CONF-871075—Vol.1-Pt.1, pp 203-214) **Hazardous waste minimization practices.** Lane, D.C.; Boggs, B.E. (Engineering-Science, Inc., Atlanta, GA (USA)). Oct 1987. NTIS, PC A15/MF A01. Order Number DE88007803/JAW.

From 3. Oak Ridge model conference on waste problems; Oak Ridge, TN, USA (13 Oct 1987).

Amendments, in 1984, to the Resource Conservation and Recovery Act require generators of hazardous waste to certify that those generators are evaluating methods to minimize the production of those wastes. Hazardous waste minimization has obvious economic benefits as well as environmental and regulatory compliance aspects. This paper reviews waste minimization practices of several industries and government agencies. These practices which are reviewed range from up front process changes, which reduce the nature or amount of waste generated, to recycling practices utilizing the waste generated and thereby removing it from the universe of wasted resources.

40182 (CONF-8609419—) **Seminar on wastewater treatment in urban areas.** (Baltic Marine Environment Protection Commission, Helsinki (Finland)). Dec 1987. 159p. NTIS (US Sales Only), PC A08;3. Order Number DE88010223/JAW.

From Seminar on wastewater treatment in urban areas; Visby, Sweden (7 Sep 1986).

A meeting on waste water treatment was held. The countries of Denmark, Finland, Federal Republic of Germany, Polish People's Republic, Sweden, and the Union of Soviet Socialist Republics participated. Topics discussed include sewerage systems; discharge of industrial waste water to municipal sewerage systems; and reduction of nitrogen. Individual projects are processed separately for the data bases. (CBS)

40183 **(CONF-8806168—1) Application of a hazardous waste management model for selected industries.** Peters, R.W.; Wentz, C.A.; Chiu, S.Y.; Martino, L.E.; Habegger, L.J. (Argonne National Lab., IL (USA)). 1988. Contract W-31109-ENG-38. 21p. NTIS, PC A03/MF A01; GPO Dep. Order Number DE88012066/JAW.

From 20. mid-Atlantic industrial wastewater and hazardous material conference; Washington, DC, USA (19 Jun 1988).

The recent development of waste minimization-waste reduction practices has furnished a focal point to address pollution prevention or minimization. Based on mass balance information, waste minimization involves various practices, including material substitution; process technology improvement; equipment improvement; and recycle, reuse, and recovery. An essential element for any successful waste minimization involves the development of a waste tracking program. The tracking program assists in the evaluation of various waste minimization alternatives being considered. Using data provided from several plating shops, various treatment technologies were evaluated with regard to their effect on the quantities of waste requiring disposal. Significant cost savings occur as a result of minimizing the water content in the waste requiring disposal. 8 refs., 5 figs., 2 tabs.

40184 **(CP—MG11877) Direct contact flue gas heat recuperator.** (Canada Packers, Inc., Toronto, Ontario). Nov 1983. 27p. (CE—01513). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

A novel boiler flue gas heat reocvery system, referred to as a direct contact heat recuperator, was installed at a Winnipeg packinghouse plant. This report details the performance of the recuperator during its first six months of operation. In contrast to conventional heat recovery systems, such as economizers and combustion air preheaters, the heat recuperator is capable of recovering up to four times more of the available waste heat from the flue gases. This is due to its ability to recover both the latent heat, by condensing the flue gas water vapour, and a greater portion of the sensible heat. As a result, the exit flue gas temperature is reduced to about 30/sup 0/C. Flue gas heat recuperators are ideally suited to operations which can make use of large quantities of hot water. Most food processing plants fall into this categroy. In the Winnipeg plant, the recovered heat is transferred indirectly to the portable hot water heating system using a plate heat exchanger. The monitoring results have shown that the average overall combustion efficiency of the boiler system has been raised from 81.8% to 92.2% percent. This improvement will result in an estimated annual fuel savings of 1,100,000 m/sup 3/ of natural gas. During the monitoring period, the recuperator was in operation an average of 86.2% of the time. In the first two months, winter conditions created freeze-up problems with the bypass damper. Thus, the initial utilization was about 60%. After this problem was solved, the utilization rate rose to its present level of over 95%. Overall, this project is considered to be very successful, both technically and financially. 1 fig., 4 tabs.

40185 **(DOE/BP—8010989) Energy conservation study on Simplot potato processing plant, Heyburn, Idaho.** (Seton, Johnson, and Odell, Inc., Portland, OR (USA)). 1 Mar 1985. 89p. NTIS, PC A05;3. Order Number DE88010989/JAW.

This report presents the findings of an energy study done at the Simplot potato processing plant in Heyburn, Idaho. The study includes all electrical energy using systems at the plant but does not address specific modifications to process equipment. The plant receives raw potatoes and produces a mixture of pre-fried and frozen potato products including french fries and pre-formed patties, a dehydrated frozen product, starch, and processes and ships raw potatoes. The plant also contains a box line that makes cardboard cartons for all Simplot plants. The plant contains all necessary equipment and processes to produce a finished product and has long-term cold storage. 13 figs., 16 tabs.

40186 **(DOE/BP—8010990) Energy conservation study on Lamb-Weston potato processing plant, Hermiston, Oregon.** (Seton, Johnson, and Odell, Inc., Portland, OR (USA)). 21 Mar 1985. 209p. NTIS, PC A10;3. Order Number DE88010990/JAW.

This report presents the findings of an energy study done at the Lamb-Weston potato processing plant in Hermiston, Oregon. The study includes all electrical energy using systems at the plant but does not address specifc modificiations to process equipment. The Hermiston plant receives raw potatoes and produces a mixture of pre-fried and frozen potato products, including french fries, breakfast products, and a dinner product. The plant contains all necessary equipment and processes to produce a finished product but does not have on-site, long-term cold storage. The Hermiston plant purchases electricity from the Umatilla Rural Electrical Association (REA) on two main services: a 12.7 KV, three phase service for the electric boiler, and a three phase, 480 volt service that provides electricity for all other functions in the main plant (the wheel-turning load).

40187 **(DOE/ID/12442—1) Beet sugar refining applications: Hydrate freeze separation program: Final report.** (Heist Engineering Corp., Walnut Creek, CA (USA)). Mar 1988. Contract AC07-83ID12442. 106p. NTIS, PC A06. Order Number DE88009812/JAW.

The beet sugar segment is the most energy intensive of the food products industry, consuming some 40 trillion Btu per year of primary fuel (the equivalent of over 13.5 million barrels a year of oil). It takes about 6700 Btu to refine 1 pound of sugar from beets. Changing factory operations to use freeze crystallization as outlined in this report and demonstrated in this program, the energy use in the industry can be reduced by about 40%. A project to accomplish full scale changes in a factory is projected to have a simple payback of just over 3 years. The sugar industry now loses about 15% of the sugar extracted from the beet. This sugar is lost in the molasses, the concentrated impurities that are extracted with sugar from the beet. One proposed use of this process described in this report is to recover a fraction of this sugar that is now lost. 28 figs., 18 tabs.

40188 **(DOE/RL/01830—T58) The US cement industry: An energy perspective.** Venkateswaran, S.R.; Lowitt, H.E. (Energetics, Inc., Columbia, MD (USA)). May 1988. Contract AC06-76RL01830. 15p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88011501/JAW.

This report investigates the state of the US cement industry in terms of energy consumption and conservation. Objectives were to: update and verify energy consumption and productions data for the various process steps as of 1985; determine the potential energy savings attainable by replacing current practices with state-of-the-art and with advanced (2010) production practices and technologies; and identify areas of research and development opportunity that will enable these potential future savings to be achieved. Results concluded that for a projected year 2010 production level, there is a potential to save between 31 and 55% of the projected energy use by replacing current technology practices with state-of-the-art and advanced technologies. R&D needs and opportunities were identified for the industry. Potential R&D candidates for DOE involvement were selected from the identified list based primarily on their energy savings potential and the opinion of industry experts.

40189 **(EMR—1986, pp 1-13) No time to be complacent.** 1986. Department of Energy, Mines and Resources, Ottawa, Ontario, Canada. (MICROLOG—88-02417).

In Canadian Industry Program for energy conservation.

This report presents an overview of activities and accomplishments of a Canadian program to improve energy conservation in industry. Since 1973, efficiency has improved 25.8%. Even though collective actions have resulted in manufacturing cost sav-

ings, the ratio of energy cost to manufacturing expense continues to rise in all sectors. The trend of leading indicators affecting future energy utilization improvements, i.e. production levels, capacity utilizations, and profits, all suggest that incremental gains will be harder to achieve in the future. In the early years of the program, efficiency gains came from a very broad base of sources, including low-cost house keeping actions; recent actions also include process improvements and major plant equipment retrofits. Overall, Canada's record of energy efficiency improvement is lagging behind the performances of other industrialized countries. 13 figs., 7 tabs.

40190 (EMR—1986, pp 73-75) **Wood Products Industry (Western) Energy Conservation Task Force.** Bryan, R.C. 1986. Department of Energy, Mines and Resources, Ottawa, Ontario, Canada. (MICROLOG—88-02417).

In Canadian Industry Program for energy conservation.

This report presents the activities of a program to promote energy efficiency and conservation in the forest industry in western Canada. Participants account for over 90% of total product value of this industry in British Columbia. An objective of the program is to increase the industry's energy efficiency 7% by 1990 from 1985. Companies in this industry include sawmills, lumber producers and plywood/veneer mills. Measures taken to conserve energy include using wood waste as fuel for kiln dryers and other equipment, and utilizing waste heat. 1 fig., 1 tab.

40191 (EMR—1986, pp 69-71) **Transportation Industry (Manufacturing) Energy Conservation Task Force.** Heidebrecht, G. 1986. Department of Energy, Mines and Resources, Ottawa, Ontario, Canada. (MICROLOG—88-02417).

In Canadian Industry Program for energy conservation.

This report presents the activities of a program to promote energy management and conservation among the members of six participating Canadian trade associations involved in the manufacture of transportation equipment. These associations include companies in the aerospace, marine, motor vehicle, and automotive parts industries, and use 80% of the total energy consumed in this part of the Canadian Transport Sector. An objective of this program is to achieve by 1990 a 10% improvement in energy efficiency over 1985. This is being carried out by implementation of more efficient equipment, improved productivity and housekeeping. Conservation measures are also promoted within the industry by various means of information gathering and exchange. 1 figs., 3 tabs.

40192 (EMR—1986, pp 65-67) **Textile Industry Energy Cosnervation Task Force.** Monton, L.G. 1986. Department of Energy, Mines and Resources, Ottawa, Ontario, Canada. (MICROLOG—88-02417).

In Canadian Industry Program for energy conservation.

This report, covering energy management activities in primary textile manufacturing in Canada, reflects an industry in transition. As a result of ongoing changes, energy efficiency improvements vary from year to year. Consumption of energy per kilo of product saw a 22.1% improvement over the first decade, as reported in 1985. Conservation activities are reported here by an estimated 86% of the industry, including all major plants with high levels of energy consumption. Primary textile manufacturing in Canada concerns itself with the production and treatment of fibers, yarns and fabrics. Both science and fashion have increasingly dictated changes in the product mix, distorting meaurement of energy consumption per kilo of product. In the fashion field, the choice of consumers has moved sharply toward fabrics using natural fibers which absorb and retain greater quantities of water than man-made filament yarns. In the wet processes (dyeing, finishing, washing, and drying), the energy needed can be 3-4 times greater per kilo of product. This is compounded by an increase in imports of untreated fabrics which then go through these wet processes in Canada. Thus more energy is used without any equivalent kilos of production being added to the efficiency calculation. Potential conservation measures used in the industry include capital improvements and use of alternate energy sources; improving efficiency through optimization of capacity utilization is another common method used in industries generally, but in the textile sector presents problems when production cutbacks are induced by waves of low-cost imports. 1 fig., 2 tabs.

40193 (EMR—1986, pp 61-63) **Pulp and Paper Industry Energy Conservation Task Force.** Paavila, H.D. 1986. Department of Energy, Mines and Resources, Ottawa, Ontario, Canada. (MICROLOG—88-02417).

In Canadian Industry Program for energy conservation.

This report describes the activities of a program to promote energy efficiency and conservation in the Canadian pulp and paper industry. Companies covered by this report account for over 90% of pulp and paper products produced in Canada. The amount of purchased energy used to produce a ton of product was 31.1% less than in the 1972 base year. This was achieved by various conservation measures including use of wood wastes as fuel, introduction of new process technologies, and waste heat utilization. 1 fig., 2 tabs.

40194 (EMR—1986, pp 57-59) **Plastics Processing Industry Energy Conservation Task Force.** Maraghi, R.; Hayter, R. 1986. Department of Energy, Mines and Resources, Ottawa, Ontario, Canada. (MICROLOG—88-02417).

In Canadian Industry Program for energy conservation.

This report presents the activities of a program to promote energy efficiency and conservation in the Canadian plastics industry. The participating companies are those that are independent from the large integrated manufacturing facilities, and include those involved in production of plastic materials and additives, processing them into products, and making plastics processing machinery, molds, and dies. Different energy management concerns and capabilites exist throughout this industry, and energy conservation methods include waste heat utilization, and thermal insulation of buildings. Total energy utilization by the participating companies has improved 35.85% since 1980. In addition, many companies are achieving energy cost savings by using natural gas. 1 fig., 2 tabs.

40195 (EMR—1986, pp 53-56) **Petroleum Refining Industry Energy Conservation Task Force.** Myers, G.G. 1986. Department of Energy, Mines and Resources, Ottawa, Ontario, Canada. (MICROLOG—88-02417).

In Canadian Industry Program for energy conservation.

This report describes activities of a program to promote energy efficiency and conservation in Canadian petroleum refineries. The participating companies process about 90% of the total industry throughput. Since 1972, energy consumption in 1986 was 27.2% lower when adjusted to an equivalent operating intensity. Specific conservation activities include improved operation and maintenance of processing equipment, capital improvements, and introduction of new technologies. 1 fig., 2 tabs.

40196 (EMR—1986, pp 49-51) **Mining and Metallurgy Industry Energy Conservation Task Force.** Fournier, R. 1986. Department of Energy, Mines and Resources, Ottawa, Ontario, Canada. (MICROLOG—88-02417).

In Canadian Industry Program for energy conservation.

This report describes the energy conservation activities of a group of companies under the auspices of the Mining Association of Canada. Its membership is comprised of major Canadian producers of a wide variety of minerals, including coal and metals. Included are all phases of operations such as smelting, milling, mining and refining. To the end of 1985, energy consumption per unit of production showed an adjusted reduction of 9.6% from the base year 1973. Due to the closure of certain operations and the creation of new ones, the base year of 1973 is no longer applicable. It was decided to adopt 1985 as the new base year and pre-1986 performance statistics have been adjusted to reflect this. The overall industry performance (adjusted for such factors as weather, changes in ore, and changes in product) was down by 3.3%. This small slippage in efficiency (1985 to 1986) is a continuation of a trend that began in 1984. The primary reason is the downward trend in energy costs since 1984. Another reason for the negative performance is the change in the base year. It was easy to show an improvement over 1973 as the industry was still relatively inefficient at that time. On the other hand, the mining industry made significant efficiency improvements prior to 1985 and as such it represents a time of relatively high efficiency. Maintaining that is somewhat more difficult. It is expected that petroleum price increases will spur future measures to enhance energy efficiency. 2 figs., 2 tabs.

40197 (EMR—1986, pp 39-43) **Industrial Minerals Industry Energy Conservaton Task Force.** Clarke, J.A. 1986. Department of Energy, Mines and Resources, Ottawa, Ontario, Canada. (MICROLOG—88-02417).

In Canadian Industry Program for energy conservation.

This report presents the activities of a program to promote energy efficiency and conservation in that part of Canadian industry that mines, processes and manufactures a variety of nonmetallic products used primarily for construction and industrial purposes. It is estimated that the companies represented in this report consume 75% of the total energy used. Overall gain in energy efficiency since 1975 has been over 24%. This has been achieved by such measures as new capital equipment, increased capacity utilization, and process improvements. Outlines of conservation measures undertaken and economics achieved are presented for the sectors of abrasives, asbestos, cement, clay products, concrete products, glass, lime, refractories and miscellaneous materials such as gypsum. 1 fig., 3 tabs.

40198 (EMR—1986, pp 33-37) **General Manufacturing Energy Conservation Task Force.** Larsen, B.K. 1986. Department of Energy, Mines and Resources, Ottawa, Ontario, Canada. (MICROLOG—88-02417).

In Canadian Industry Program for energy conservation.

This report describes activities of a program to promote energy efficiency and conservation in Canadian manufacturing. Participants are members of the Canadian Manufacturers' Association and represent a diverse group with different energy intensities, for example, light manufacturing, founderies, chemical producers, and metal processors. Overall efficiency has improved 25.3% over 1981 standards. Conservation and other energy management strategies vary with the type of industry, and this report outlines efforts made by industry groups as well as for manufacturing as a whole. The large percentage of companies assigning energy management responsibility to plant managers or engineers suggests that specific improvements continue to focus primarily on the end-use of energy where well-known technologies can be applied. Other conservation strategies in use include housekeeping actions, waste heat utilization, building insulation, and use of natural gas for fuel. 1 fig., 2 tabs.

40199 (EMR—1986, pp 45-47) **Machinery Industry Energy Conservation Task Force.** Garlick, W.D. 1986. Department of Energy, Mines and Resources, Ottawa, Ontario, Canada. (MICROLOG—88-02417).

In Canadian Industry Program for energy conservation.

This report describes the activities related to energy efficiency and conservation operating under the auspices of the Machinery and Equipment Manufacturers' Association of Canada (MEMAC). MEMAC membership is comprised of companies engaged in the production of a wider range of industrial machinery and equipment required by Canada'a resource, processing, manufacturing and service industries, excluding farm and industrial equipment covered by the Canadian Farm and Industrial Equipment Institute. The industry's typical products include conveyors, mining machinery, equipment and valves. The machinery industry has already surpassed its 1990 target figure of a 15% increase in energy efficiency over 1975. Not only are member companies implementing energy conservation measures in their plants, they are also making efforts to design their products for enhanced energy efficiency. Many companies are becoming very sophisticated in their methods to control energy costs. 2 figs., 1 tabs.

40200 (EMR—1986, pp 27-31) **Food and Beverage Industry Energy Conservation Task Force.** Hyland, A.L.W. 1986. Department of Energy, Mines and Resources, Ottawa, Ontario, Canada. (MICROLOG—88-02417).

In Canadian Industry Program for energy conservation.

This report describes the energy management performance of companies representing over 400 individual operations throughout 13 different trade associations of the Canadian food and beverage industry. Their objective is to achieve a net gain in energy efficiency of 31% by 1990 (using 1976 as the base year). The means used to achieve improved energy conservation and efficiency vary between the various kinds of industries, and this report briefly describes typical energy conservation practices in bakeries, breweries, distilleries, candy makers, food processing, fisheries, grocery products, meat packers, poultry and egg processors, and producers of soft drinks, starch, and sugar. Such practices include installing more efficient equipment, waste heat recovery, and fuel substitution. 1 fig., 4 tabs.

40201 (EMR—1986, pp 23-25) **Ferrous Metals Industry Energy Conservation Task Force.** Cotie, W. 1986. Department of Energy, Mines and Resources, Ottawa, Ontario, Canada. (MICROLOG—88-02417).

In Canadian Industry Program for energy conservation.

This report presents an outline of the activities of a program dedicated to promoting energy efficiency and conservation in the Canadian steel industry. Companies participating in this program represent about 85% of total Canadian raw steel production, and their objective is to reduce the energy consumed per tonne of steel produced to 20.91 GJ by 1990. This is gradually being done by new energy efficient installations, equipment modifications, operating changes, and preventive maintenance. Information on new conservation techniques is disseminated through seminars and committee meetings. 2 figs., 2 tabs.

40202 (EMR—1986, pp 19-21) **Electrical and Electronic Industry Energy Conservation Task Force.** Torbet, P. 1986. Department of Energy, Mines and Resources, Ottawa, Ontario, Canada. (MICROLOG—88-02417).

In Canadian Industry Program for energy conservation.

This report describes the activities of a program to increase energy efficiency and promote conservation in the Canadian electrical/electronics industry. The companies participating in this program manufacture a variety of products used in repoduction, transmission and generation of electricity and related electronic systems and components. Since 1975, energy efficiency in this sector has improved 38%. Methods for achieving such efficiency range from simple housekeeping measures to energy management programs which emphasize improved processes. 1 fig., 2 tabs.

40203 (EMR—1986, pp 15-17) **Chemical Industry Energy Conservation Task Force.** Shearing, D. (Energy Conservation Task Force, Canada). 1986. Department of Energy, Mines and Resources, Ottawa, Ontario, Canada. (MICROLOG—88-02417).

In Canadian Industry Program for energy conservation.

This report presents energy usage and conservation data for the chemical industry in Canada, based on an annual survey of member companies of the Canadian Chemical Producers' Association. These companies produce a broad range of manufactured chemicals for domestic and export markets. This report represents 75% of the total chemical industry. The survey includes costs of fuel and electricity. The cost of feedstocks is not included in the survey because the reporting methodology treats any improvements in raw material conversion rates as total plant efficiency gains and therefore as improvements in the utilization of fuels. Outline is given of the various types of improvements undertaken in the industry. These have tended to include activities that focus on combustion and steam distribution systems, increased fuel switching to minimize total operating costs, cogeneration, byproduct utilization, and upgrading of distillation equipment. Some case studies are presented. Energy conservation activities have resulted in a total improvement in energy efficiency up to 1986 of 34.4% based on the 1972 base year. 1 fig., 2 tabs.

40204 **(EMR—1986) Canadian Industry Program for energy conservation.** (Department of Energy, Mines and Resources, Ottawa, Ontario (Canada)). 1986. 84p. (MICROLOG—88-02417). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1. $0.34 CAN per page, $3.40 minimum; MF $10 CAN.

This report outlines the activities of a Canadian program, sponsored by government and administered by industry, for promoting and monitoring energy efficiency throughout Canadian industry. Program objectives include coordination of industry efforts to conserve energy. Task force reports are included for various categories of industries. Separate abstracts have been prepared for fifteen papers from this report.

40205 (ESA-SP—279) Proceedings of the 3rd European space mechanisms and tribology symposium. Hunt, J. (European Space Agency, 75 - Paris (France)). Dec 1987. 324p. (ETN—88-91973; CONF-8709305—). NTIS, PC A14/MF A01.

From 3. European space mechanisms and tribology symposium; Madrid, Spain (30 Sep 1987).

Spacecraft pointing mechanisms, booms, deployable structures, latches, tribology, components and instruments, and testing were discussed.

40206 (EUR—10553-DE) Heat pumps for heat recovery from paper dryers, producing process steam from the dryer exhaust air. Final report. Friedel, W.; Gramatte, W.; Hampel, H.J.; Schneider, R.; Wittekind, J.; Vack, K.; Ruediger, B. (Commission of the European Communities, Luxembourg. Directorate General Telecommunications, Information Industries and Innovation; Battelle-Institut e.V., Frankfurt am Main (Germany, F.R.)). 1986. 122p. (In German). Commission of the European Communities, Luxembourg. Office for Official Publications of the European Communities.

Energie.

Different possibilities have been studied to produce heat at 125-145/sup 0/C for a paper dryer from its waste heat at 80-90/sup 0/C. A comparison of the possible systems was made regarding technical feasibility, energy saving potential and costs. The two-staged absorption heat pump with LiBr/H/sub 2/O was found to be able to work under the specific operating conditions of the reference paper machine. A 100 kW heat pump of this type was built and tested on a test rig. As a result of these tests the following modifications are being brought about: Installation of a pump to control the solution and avoid crystallization of LiBr, continuous measurement of the LiBr concentration, design of a new LiBr solution distribution system and replacement of the solution heat exchanger by a new apparatus with low losses. (orig.)

40207 (NP—8770286) Innovative low-temperature heating systems for foil-type greenhouses: HYDROSOL systems and porous pebble floor heating systems utilizing waste heat from a thermal swimming pool. Theoretical feasibility and practical experiences. Schackmann, V. (Fachhochschule Ravensburg-Weingarten, Weingarten (Germany, F.R.). Fachbereich Physikalische Technik). Oct 1986. 132p. (In German). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88770286/JAW.

The detailed report deals with two innovative low-temperature heating systems supplying horticultural foil-type greenhouses with waste heat from the local thermal swimming pool. A description of the object as such (site, structure, floor and roof heating systems) is followed by an account of theoretical aspects, i.e. energy balances, heat transfer through the floor heating system and through the greenhouse skins (with and without atomization). Access is given to measurements (sensors, measuring points) and tests of both the floor heating system (porous pebbles) and the HYDROSOL roof heating system which through the atomization of water in-between foils can utilize the water trickling from the surface of the inner foil. A combination of both systems (heat losses, temperature control) is presented by way of a comparative evaluation. Innovative systems such as these allow for the cultivation of young plants during the winter season. (HWJ).

40208 (PB—88-182902/XAB) Boiler efficiency-improvement manual: energy-saving techniques for boiler operators and owners (revised). Chahill, A.K.; Steven, P.E.; Tuma, L.; Elbl, M. (Illinois Dept. of Energy and Natural Resources, Springfield (USA)). Jun 1987. 80p. (IL/ENR/CO—87/02). NTIS, PC A05/MF A01.

See also PB—262-577.

The manual covers a broad range of state of the art techniques and maintenance practices to maximize boiler operating efficiency. It should enable the boiler operator to chose energy-savings options which are most suited to his own system.

40209 (PB—88-201637/XAB) Investment in energy cost savings. A study of delivery by Dutch trade and industry. van Wees, F.G.H.; Boswinkel, H.H.; Duijves, K.A.; Gerbers, D.; Kruijswijk, B.J. (Stichting Energieonderzoek Centrum Nederland, Petten. Energie Studie Centrum). Oct 1986. 344p. (In Dutch). (ESC—36). NTIS, PC E12/MF A01.

The report presents the results of a study to determine the expected share of Dutch domestic firms in the production and delivery of energy-saving equipment installed in the Netherlands in the period 1990-2000. Thirteen types of important energy-saving techniques are considered. Based on savings realized in terms of energy and money and the level of required (additional) investment, the profitability of these techniques are calculated. From the theoretically available market potential and additional constraints, the total market penetration level in the period 1990 to 2000 is estimated. For each technique, the share of imports and domestic production are established. In addition to the production of equipment, the contribution of Dutch engineering and installation firms are also taken into account. By means of this procedure it is stipulated that Dutch firms may contribute about 80% of the total value of energy savings equipment in the period considered.

40210 (STF—11A88010) Evaluation of heat pumps/heat exchanger systems in hatcheries. Annual report 1987. Eggen, G. (SINTEF, Trondheim (Norway)). Jan 1988. 48p. (In Norwegian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88753735/JAW.

The report deals with the heating systems for hatcheries, and focuses on heat pump/heat exchanger systems. The following aspects are discussed and compared: Sizing and operation of heating systems to increase the production capacity of one-year smolt at beneficial cost levels; periphyton- and fouling conditions at the outlet of heat exchangers. Practical experiences from the various water treatment- and washing/cleaning measures are given, and are based on bench-scale experiments and field tests. 12 drawings, 1 table, 31 references.

40211 (STU—83-3006B) Experimental greenhouse at the Stockholm County Council school of horticulture at Saeby-holm. Fryxell, R. (Swedish National Board for Technical Development, Stockholm). 24 Jul 1986. 207p. (In Swedish). NTIS (US Sales Only), PC A10. Order Number DE88753751/JAW.

The aim of the experiment was to construct a tight, highly insulated, low energy and light intensive greenhouse in which demanding cultures could be cultivated troughout the year. Furthermore the house should have an open floorspace without blocking or shading structures, and be equipped with an airflow and ventilation system which makes airing unnecessary during the cold season. A day to night energy storage system should replace conventional heating. The house is erected on a concrete strip foundation in which heating coils are located. Furthermore, on the top of the cantilever are two layers of transparent plastic foil. Between the layers, removable insulating porous polystyrene balls will be filled or removed as outdoor temperature and light vary. The climate air passes the evaporators of three heat pumps and is then blown through an air/water heat exchanger and an electric radiator. The heat exchanger is supplied with hot water from a water tank heated by the heat pumps. When needed the air will be reheated in the heat exchanger and radiator. The heat evolved when the air is in the heat pump evaporators is stored in the water tank, in a salt storage and in the concrete floor with its heating coils. At night when outdoor temperature is low heat is transferred from the heat storage to the greenhouse. When inside temperature or humidity becomes too high, outdoor air is added. From the two experimental periods 1982-1984 it is concluded that after certain modifications of the equipment it would be possible to grow Swedish garden produce all the year round without excessive heating costs.

40212 Sulfur solubility in pure and mixed organic solvents. Sciamanna, S.F.; Lynn, S. (Dept. of Chemical Engineering, Univ. of California, Berkeley, CA (US)). *Industrial and Engineering Chemistry Research;* **27**: No. 3, 485-491(Mar 1988).

Data on the solubility of sulfur in organic solvents were needed for the development of the University of California, Berkeley, Sulfur Recovery Process. Sulfur solubility was measured in a variety of poly(glycol ethers), in N,N-dimethylaniline and quinoline, and in mixtures of some of these solvents. Special techniques were developed for making these measurements. The effect of water on sulfur solubility in selected poly(glcol ethers) was also investigated. The results indicate that, of the poly(glycol ether) solvents tested, the best solvents for sulfur are the dimethyl ethers of di(and higher)ethylene glycol.

40213 **Solubility of hydrogen sulfide, sulfur dioxide, carbon dioxide, propane, and n-butane in poly(glycol ethers).** Sciamanna, S.F.; Lynn, S. (Dept. of Chemical Engineering, Univ. of California, Berkeley, CA (US)). *Industrial and Engineering Chemistry Research;* **27**: No. 3, 492-499(Mar 1988).

Data on the solubility of acid and hydrocarbon gases for poly(glycol ethers) are necessary for the development of the University of California, Berkeley, Sulfur Removal Process. An automated gas solubility measurement system was used to collect data on the solubility of hydrogen sulfide, carbon dioxide, propane, and n-butane in a variety of these solvents. The partial pressure of solute gas in these experiments was between 3 and 100 kPa. Correlations for Henry's law coefficients are given as a function of temperature. Gas solubility in the organic solvents decreases when small amounts of water (<6 wt %) are also present. Gas solubility in solvent-water mixtures at the conditions tested is shown to follow a simple mixing rule. An improved correlation is presented for previously published solubility data for sulfur dioxide, which includes the effect of composition as well as temperature on the Henry's law coefficient.

40214 **Innovations in materials and materials processing: the potential for energy conservation.** Curlee, T.R. (Oak Ridge National Lab., TN (USA)). *Materials and Society;* **12**: No. 1, 1-45(1988).

Findings are presented of a preliminary study to assess the energy-conservation potential of several innovations in materials and materials processing. Five main areas are assessed: (1) lightweight materials in automotive applications, (2) thermal insulation for residential buildings, appliances, and industrial equipment, (3) processing of steel, aluminum, copper, and pulp and paper, (4) high-temperature materials for automotive heat engines and industrial heat exchangers, and (5) corrosion-resistant materials for automobiles. For each of the areas assessed, two main questions were posed: (1) given that a particular innovation is successfully developed, what are the technical possibilities for improvements in fuel efficiency? The technical literature was reviewed to assess the potential impacts of these new innovations on fuel requirements in production and/or use of selected products; (2) given that the new technologies successfully penetrate the markets, how much energy could be conserved in the aggregate, and how much would the reductions in fuel use be worth to the typical adopter of the new innovations? Findings of the study indicate that adoption and use of these selected materials and materials-processing technologies could result in technical reductions in energy consumption. Various simplifying assumptions were, however, made with respect to the individual technologies. 62 references, 19 tables.

40215 **Fiber optic chemical sensors for industrial and process control.** Miller, H.H.; Hirschfeld, T.B. (Lawrence Livermore National Lab., Livermore, CA (US)). pp 39-46 of Fiber optic and laser sensors IV. De Paula, R.P.; Udd, E. Bellingham, WA; SPIE Society of Photo-Optical Instrumentation Engineers (1986). (CONF-8609127—).

From SPIE symposium on optics and optoelectronics; Cambridge, MA, USA (14 Sep 1986).

Fiber optic sensors have been developed for monitoring in-plant gaseous emissions of ammonia, formaldehyde, organohalides, hydrogen sulfide, carbon dioxide, oxygen and nitrogen dioxide. In addition, industrial, process control sensors for real-time process or effluent monitoring have been developed for measuring the aqueous concentrations of such ions as H+, NA+, K+ UO/sup ++//sub 2/, as well as organohalides. Some of these fiber optic sensors, or optrodes, are reversible and are engineered to remain in place for periods up to one year. Other optrodes are nonreversible and require replacement of the sensor tip every 1-2 days. The design and sensitivity of selected optrodes are described as well as applications.

3206 Municipalities And Community Systems

REFER ALSO TO CITATION(S) 39725, 39834, 40013, 40070, 40118, 40182, 41353

40216 **(AD-A—189077/1/XAB) Techniques for improving energy efficiency at water-supply pumping stations. Final report.** Ormsbee, L.E.; Walski, T.M.; Chase, D.V.; Sharp, W.W. (Army Engineer Waterways Experiment Station, Vicksburg, MS (USA). Environmental Lab.). Nov 1987. 242p. (WES/TR/EL—87-16). NTIS, PC A11/MF A01.

This report presents an application of a methodology for reducing the amount of energy used for pumping in treated-water-distribution systems. The methodology can be divided into three steps: (a) field testing of pumps to ensure that they are performing to specifications, (b) determining the best combination of pumps to achieve a given discharge, and (c) determining the optimal discharge (or tank-water levels). The methods presented in the report are applied to pumping stations serving the water distribution system for Washington, DC, and the vicinity. They indicate that energy savings of approximately 5% ($90,000 per year for the two pressure zones investigated) can be realized without adversely affecting service. The methods can be used in developing rough rules for pump operation or for real-time control of pumping.

40217 **(DOE/CE/26557—T1) An assessment of district heating and cooling potential in Joliet, Illinois: Phase I technical and economic feasibility study, final report.** (Enerteq Sciences, Inc., Western Springs, IL (USA)). Nov 1987. Contract FG01-86CE26557. 79p. (ESI/COJ—87-001). NTIS, PC A05/MF A01;1; GPO Dep. Order Number DE88011555/JAW.

A preliminary assessment of the technical and economic feasibility of a district heating and cooling (DHC) system serving a portion of Joliet, Illinois, has been completed. The basic system, which was designed to provide thermal and electrical energy services to the assessment area, was found to be economically feasible while providing energy services at prices that are less than or equal to current costs. The DHC assessment area included the following: the Downtown Business District; the newly-designated Heritage Business Park; and the Joliet Correctional Center. The Heritage Business Park is the site of a former steel wire and rod mill. Approximately one-third of the site is currently occupied by a rod mill operated by American Steel and Wire while the rest of the Park is essentially undeveloped. In late 1985, plans were formulated to redevelop the site into an industrial park for light industry, offices and research and development facilities. The installation of a DHC system over the next five to ten years would not only complement the redevelopment of the Downtown Business District that was recently begun, but would help to encourage the eventual development of the Heritage Business Park as well.

40218 **(NYSERDA—87-32) Pilot anaerobic fluidized bed treatment of municipal sludge at Nassau County: Final report.** (New York State Energy Research and Development Authority, Albany (USA)). Jul 1987. 141p. Unlimited audience, publicly available. NYSERDA, Two Rockefeller Plaza, Albany, NY 12223. Order Number TI88012457/JAW.

The pilot study was conducted at the Nassau County Bay Park Sewage Treatment Plant to determine the feasibility of using the anerobic fluidized bed process for the treatment of municipal sewage. Three pilot reactors were set up and operated to test the concept. The main pilot reactor was constructed out of 2-foot-diameter clear acrylic and was 16 feet high. This reactor treated a flow rate on average of approximately 2000 gallons per day of primary settled sewage. The two other pilot reactors were 6 inches in diameter by 10 feet high and identical in construction. These reactors were used to test different fluidized bed media and to pre-test operating conditions before changes were made on the large pilot reactor.The pilot plants were operated over a one-and-one-half-year period under varying operating conditions. Two different medias were investigated as the carrier particles for the biomass in the flu-

idized bed reactors (granular activated carbon and sand). Although sand is a significantly less expensive media, activated carbon also was tested because of concern over the dilute nature of municipal sewage.

40219 **(SNC—121981) Production of electricity generation by wood-fired steam engines for remote communities. Final report.** (SNC Group, Montreal, Quebec (Canada)). Dec 1981. 86p. (CE—01698). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

The study investigated the requirements and potential of installing small wood-fired steam based electrical generating installations within the existing remote northern communities of Canada. Comparisons between the utilization of steam engine prime movers drew no clear cut conclusions that one or the other was superior. Although not clearly illustrated in this study, (only one power level comparison considered), the smaller communities' use of steam engines would be advantageous. In the larger communities the turbine bevomes much more cost effective. A range of power outputs exists (of the order of 500 kw to 2000 kw) where either system might prove desirable. It must be emphasized that the selection of any system will vary with individual case communities. The simplicity of operation and maintenance and reliability due to conservative design standards offer great advantages for remote community application. The relative merits of the several types of proven wood combustion techniques were also studied. From consideration of the various equipment options (i.e. turbine based or engine based), preferred systems for one power level of 1250 kw were developed as a base for budget capital investment requirements. The associated operating and maintenace costs were also developed to complete the economic picture. 11 refs, 19 figs.

3209 Education And Public Relations

REFER ALSO TO CITATION(S) 40164, 40167, 40175

40220 **(PPF—031979) Consumer reaction to reduced packaging in the supermarket.** Loveys, M.J.; Pim, L.R.; Robson, N.C. (Pollution Probe Foundation, Toronto, Ontario (Canada); Stevenson and Kellogg Management Consultants, Toronto, Ontario (Canada)). Mar 1979. 30p. (CE—01504). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

The focus of this study is the notion that much of the current packaging of consumer products could be eliminated without jeopardizing the various functions served by the package. Reducing the materials and energy inputs into product packaging could save the consumer money and lessen the waste disposal problem, as well as conserve natural resources for more essential uses. The hypothesis tested was that the consumer prefers a heavily packaged product in the supermarket and is willing to pay for that level of packaging, even when a lightly packaged and lower-cost form of the product is provided. To test this hypothesis, ten food and seven non-food products in two Toronto outlets of a supermarket chain were each displayed with and without their exterior layer of packaging. A price difference was established between the two forms of the product display to reflect the cost of the package. Sales were recorded over a four-week period. Seven of the 17 products tested showed close to or above 50% of total sales in lightly packaged form. The mean percentage of sales in the light packages of 41.3% indicates that there is substantial consumer acceptance of less costly packages. There was no consistent pattern of purchases separating food and non-food products with respect to packaging chosen, nor in light versus heavy packaging relative to the price differentials. Also, there was no relationship between the sales success of the lightly packaged forms and the amount of color on those packages. 15 refs., 5 tabs.

40221 **(WL/BE—1981) Energy: Canadians' attitudes and reactions (1975-1980).** McDougall, G.H.G.; Keller, G. (Wilfrid Laurier Univ., Waterloo, Ontario (Canada). School of Business and Economics). 1981. 40p. (CE—01422). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

Analysis of 6 1975-80 surveys of Canadian public attitudes towards the energy situation was undertaken in this report. Some conclusions were as follows. An increase was shown in the number of Canadians who consider energy as one of the problems facing Canada because of its increasing cost (rather than fear of shortages). The proportion of those who think the energy shortage is serious has remained stable since 1976 at about 60%, with more people concerned about gasoline and heating fuel shortages than with natural gas and electricity. There has been an increase in those who claim they engage in energy conservation behavior; a related attitude is that Canadians believe that individual efforts to conserve energy are important. There is no demographic characteristic consistently related to attitudes and behavior, but there are some geographic ones: Halifax and Ottawa residents view the energy problem more seriously than other urban residents, Calgary residents less seriously. Government policies to ration energy or increase prices would meet with heavy resistance; advertising and financial incentives are preferred as policies to meet conservation problems. Past government information programs have reached up to 40% of the public. Two major groups were identified among the public: the hostiles, who think the energy issue is a bit of a hoax, and the knowledgeables, who have a positive conservation attitude and a high degree of energy related knowledge. Some demographic characteristics of these groups are described, and recommendations are made on the kinds of government information programs that should be pursued. 22 tabs.

40222 **(YU/FAS—011983) Early adopters of energy conservation products in Winnipeg: a case study. Final report.** Fenwick, I.; Simmie, P.; Heeler, R. (York Univ., Toronto, Ontario (Canada). Faculty of Administrative Studies). Jan 1983. 110p. (CE—01526). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

The purpose of this study was to identify early adopters of energy conservation technologies, to identify energy conservation opinion leaders, to determine consumers' perceptions and evaluations of a set of energy conservation product concepts and to relate these perceptions and evaluations to consumers' innovativeness. The first part of the report reviews the available literature on early adoption as it applies to energy conservation. The second part applies this review to developing a questionnaire administered by mail to a random sample of homeowners in Winnipeg. The survey was designed to appeal particularly to those interested in energy conservation and those owning energy conservation products. As a result these individuals will be over-represented in the returned questionnaires. Early adopters, defined as owners of 4 or more energy conservation products, tended to be upscale in demographics, to be opinion leaders, to be socially integrated, to rate themselves as innovative and to agree that they drove less. Early adopters were more discriminating in their product perceptions and more likely to be aware of new energy conservation products. Individuals' interest in buying the new energy conservation product tested could be accurately predicted using only their preceptions of the product's relative advantage, communicability and compatibility. Relative advantage was by far the most important factor. There was some evidence that payback period was the most important aspect of relative advantage, although consumers were only sensitive to large changes in payback period. 25 tabs.

33 ADVANCED AUTOMOTIVE PROPULSION SYSTEMS

3301 Internal Combustion Engines

REFER ALSO TO CITATION(S) 39203, 39204, 40232, 40237, 40240

40223 (AD-A—191075/1/XAB) Servojet retrofit. Final report, August 1986-June 1987. Barkhimer, R.L.; Beck, J. (BKM, Inc., San Diego, CA (USA)). Jul 1987. 92p. NTIS, PC A05/MF A01.

The authors discuss the design and demonstration of a retrofit diesel-engine fuel system of an advanced high-pressure concept. By applying the principle of a spill-port-operated accumulator injector, the system is projected to enhance starting, as well as the idle and part-load operating characteristics of existing engines. The system was given the model designation SR-1.

40224 (AD-A—191166/8/XAB) Predictions of probabilities of sustained fires for combat-damaged vehicles. Technical report, July 1985-August 1986. Finnerty, A.E. (Army Armament Research and Development Command, Aberdeen Proving Ground, MD (USA). Ballistics Research Lab.). Nov 1987. 68p. (BRL-TR—2875). NTIS, PC A04/MF A01.

A simple model was used to predict combat induced fires of flammable components (except ammunition) carried on combat vehicles. Five U.S. Army ground vehicles were examined. Eight attacking weapons were considered. Fuel temperatures from 8 to 53 C were included. The model was based as much as possible on existing data which simply did not cover all situations of interest. Considerable personal judgment was required. Nevertheless, the importance of certain vehicle properties include engine design, fuel-cell location, vehicle material, and the presence of an automatic fire-suppression system.

40225 (AD-A—191277/3/XAB) Development of cost-effective manufacturing process for producing ceramic turbocharger rotors. Volume 1. Final report, October 1985-June 1987. Kobayashi, R.J.; Mullen, R.L.; Baker, D.E.; Yeh, H.C. (Allied-Signal Corp., Torrance, CA (USA). Garrett Automotive Group). 14 Aug 1987. 86p. NTIS, PC A05/MF A01.

Ceramic turbine rotors for turbochargers, because of the material's low density, offer faster turbocharger rotor acceleration which improves engine response and vehicle acceleration. Ceramics use relatively low-cost materials instead of the currently used expensive, exotic, and sometimes scarce-metal elements and, hopefully, will allow the production of less-expensive rotors. Only in the past few years have prototype ceramic rotors been produced. The U.S. Army Tank-Automotive Command (TACOM) established a program to demonstrate the feasibility of producing a cost-effective ceramic rotor for military use with Garrett Automotive as the prime contractor and the AiResearch Casting Company (ACC) as the major subcontractor. While ACC has been able to produce small (passenger car) ceramic rotors, within the timeframe of this program, ACC was not able to produce a satisfactory large turbocharger rotor. A major goal of this program was to develop a domestic source for rotor production, but from Garrett's experience no other U.S. company was capable. Therefore, to conclude the program with demonstration hardware, a Japanese supplier of known capability (Kyocera) was asked to make the rotors.

40226 (NP—8770290) Study of influence factors on combustion processes in a diesel car engine with direct fuel injection. Zima, P. (Technische Hochschule Aachen (Germany, F.R.). Fakultaet fuer Maschinenwesen). 10 Dec 1984. 142p. (In German). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88770290/JAW.

An experiment was carried out to study the influence of the injection rate, the intake swirl level, the nozzle orifice geometry and the shape of the combustion chamber bowl on the operational performance of a fast-running, free-suction diesel car engine with a predominantly air-distributing mixture formation. The object of the study was to mitigate the typical drawbacks of the process, such as unsatisfactory air utilisation, high combustion-noise level and unfavourable pollutant emissions, which had not yet been eliminated. The effects of variations in the individual parameters on engine performance were identified from measurements of power output, fuel consumption and pollutant emissions, and of the thermodynamics and acoustics based on injection of the cylinder pressure. Detailed comments are made on the present state of development of the small-capacity, fast-running diesel engine with direct fuel injection, the influence factors mentioned above and the steps taken in the experiment. The conclusion draws comparisons between the direct fuel injection engine and the two-chamber engine. The major findings are summarised in 11 points.

40227 (PB—88-197074/XAB) Development of power-recovery gas-turbine system for main diesel engine. Utsunomiya, M.; Mori, T.; Sugihara, H.; Sato, K.; Tanaka, H. (Ishikawajima-Harima Heavy Industries Co. Ltd., Tokyo (Japan)). 1988. 7p. NTIS, PC E03/MF A01.

Included in IHI (Ishikawajima-Harima Heavy Industries) Engineering Review, Vol. 21, No. 1, 8-13(1988).

In order to further improve thermal efficiency of the present marine diesel engines, power recovery from exhaust gas energy by a gas turbine is an effective measure. The latest models of high-efficient turbochargers can induce surplus exhaust gas into the power recovery gas turbine where the exhaust gas energy is directly converted into motive power. The methods to utilize the recovered power to save energy of a propulsion plant totally were established in the form of ED-Turbo S/G system, SSG Mark-V system and PR-Turbo, which were actually applied to several vessels. The paper outlines the development of the power-recovery gas-turbine system together with the shop test results of the first main diesel engine with the gas turbine. The system performance has been fully confirmed by the tests.

40228 Rotary detonation engine. Eidelman, S. (to Secretary of the Navy). US Patent 4,741,154. 3 May 1988. Filed date 26 Mar 1982. vp. Patent and Trademark Office, Box 9, Washington, DC 20232.

In an engine of the type wherein the combustion of the fuel mixture is carried out by a detonation wave, the improvement is described comprising: (a) an elongated shaft having a central longitudinal chamber, the chamber being supplied with a detonatable fuel mixture; (b) axisymmetrical elements integral with the shaft and disposed along the length thereof; (c) means for selectively introducing the detonatable mixture from the central chamber into the initiation chamber of each axisymmetrical element and the ducts of the axisymmetrical element; and (d) means for selectively initiating detonation of the fuel mixture in the initiation chamber of each the axisymmetrical element, whereby ignition and detonation of fuel mixture in the initiation chamber will produce a detonation wave which travels outward from such initiation chamber in the ducts to initiate fast combustion of the fuel mixture in the ducts. The combustion products are exhausted from the exhaust openings in the form of high speed jets oriented to produce a rotational moment in the element and the shaft.

3302 External Combustion Engines

REFER ALSO TO CITATION(S) 40771

40229 Free-piston Stirling engine-driven heat pump program plan. Ross, B.A.; Hutchinson, R.A.; Chen, F.C. (Pacific Northwest Lab., Richland, WA (US)). pp 1759-1764 of Proceedings of the 22nd intersociety energy conversion engineering conference. New York, NY; American Institute Aeronaut and Astronaut (1987). (CONF-870804—). Contract AC06-76RL01830.

From 22. intersociety energy conversion engineering conference; Philadelphia, PA, USA (10 Aug 1987).

Technical Paper 879030.

Stirling engine driven heat pumps are one of the most attractive potential products based on Stirling engines. Their many advantages in efficiency, fuel adaptability, quietness, compactness, controllability and potential for high reliability are well known. This paper briefly reviews these advantages, then turns to key tech-

nical concerns in Stirling engine driven heat pump development. These have been organized into an effective development program that will require about /4 million per year for 8 years to complete basic research, component development, and an estimated 3 generations of system hardware. The planning effort was directed by the Building Equipment Division of the DOE Office of Buildings and Communities Systems.

3303 Electric-powered Systems

REFER ALSO TO CITATION(S) 39979, 39985, 39991

40230 **(UTDCRD—584302001) Application of Sailrail technology to the transit industry.** (UTDC Research and Development Ltd., Kingston, Ontario (Canada)). 30 Jun 1983. 74p. (CE—01510). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

The concept of marrying compliant air bearing technology with Linear Induction Motor in track technology to create a new transportation product (SailRail) was examined from a market perspective and an engineering feasibility perspective. The existing competition in the low-capacity people-mover market was surveyed in terms of performance and cost. Additionally, two application examples were examined to determine criteria for the engineering study: low-speed mass transport between buildings and sites at Toronto International Airport and at Expo 86 in Vancouver. Using one application scenario, the product was evaluated in terms of operational performance, requiring evaluation of vehicle design, guideway design, and operating system design. Additional questions such as curving and crossovers were examined. The study concludes that the concept provides the potential for high quality, low cost mobility and in addition a new potential market application was discovered which is not served by existing products. 16 figs., 6 tabs.

3304 Hybrid Systems

REFER ALSO TO CITATION(S) 39979

3307 Emission Control

REFER ALSO TO CITATION(S) 39150, 40241, 40523, 41355

40231 **(GAO/RCED—85-22) Vehicle emissions inspection and maintenance program is behind schedule.** (General Accounting Office, Washington, DC (USA)). 1985. 54p. US General Accounting Office, PO Box 6015, Gaithersburg, MD 20877.

Under the Clean Air Act, 30 states and the District of Columbia are to implement vehicle emissions inspection and maintenance (I/M) programs to ensure that carbon monoxide and ozone air quality standards will be attained by the end of 1987. As of September 1984, most of the states has implemented an I/M program; however, these programs are controversial because their benefits are not always clear and costs are considerable. GAO believes EPA's scheduled audits should be completed by the close of fiscal year 1986 so that states can benefit from any EPA recommendations before the 1987 deadline.

40232 **(PB—88-193073/XAB) Initial testing of the tunable-diode-laser absorption spectrometer for measuring HNO_3 in diesel engine exhaust. Stage II. Final report.** Harris, G.W.; Mackay, G.I.; Mayne, L.K.; Schiff, H.I. (Unisearch Associates, Inc., Concord, Ontario (Canada)). 29 Oct 1987. 36p. NTIS, PC A03/MF A01.

See also PB—85-212967.

Unisearch's tunable diode laser absorption spectrometer designed for tropospheric air monitoring (TAMS-2B) was used at the Ontario Research Foundation Diesel Dynamometer test facility to investigate the effect of the dilution tunnel and sampling system on HNO_3 measurements for different engine operating conditions. Preliminary measurements were also made on HCHO to assess the ability of the TAMS-2B to make real time measurements of this species in diesel engine exhaust. Nitric acid and HCHO were measured in the rage of 40-800 ppbv and 3.5-5.5 ppmv, respectively. The mixing ratio of HNO_3 was found to decrease as engine load was increased, while the reverse was found for HCHO. The HNO_3 levels exhibited slow response (1-30 min) for changes in engine operating condition. Similar response times were observed when controlled spikes of HNO_3 were added to the diluted exhaust gas flow but the response time of the instrument itself to added HNO_3 was more rapid. In marked contrast, the response to HCHO was immediate. Results also indicate that the observed HNO_3 is present in the exhaust stream immediately after dilution and is not produced by subsequent reactions of NOx.

40233 **(PB—88-193099/XAB) Study of uncontrolled automotive refueling emissions. Final report.** Cingle, P.; McClement, D. (Automotive Testing Labs., Inc., East Liberty, OH (USA)). 5 Jan 1988. 99p. (CRC-APRAC-VE—6). NTIS, PC A05/MF A01.

Twenty-two (22) late model vehicles, representing a variety of fuel-system geometries from eight different manufacturers, were tested to determine uncontrolled refueling emissions. The effects that fuel RVP, dispensed fuel temperature, differential temperature between the vehicle's tank temperature and the dispensed fuel temperature, and fuel tank and inlet pipe geometries have on refueling emissions were studied. Three factors were found to significantly affect a vehicle's refueling emissions: fuel RVP, dispensed fuel temperature, and the differential temperature between the vehicle's tank temperature and the dispensed fuel temperature. A variety of fuel-system geometries were represented in the study, however, none were found to be significant. A correlation equation was derived from the study.

3308 Alternative Fuels

REFER ALSO TO CITATION(S) 39152, 39203, 39204, 39451, 40049

40234 **(INCO/M—031987) Examination of the 100% methanol engine as a power source for underground mines. Final report.** (Inco Ltd., Mississauga, Ontario (Canada)). Mar 1987. 56p. (MICROLOG—88-01557). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1. $0.34 CAN per page, $3.40 minimum; MF $10 CAN.

A Deutz F8L41F diesel engine was modified to use methanol. The principal modification consisted of using special glow plugs with an electronic control system to provide a continuous source of ignition for the methanol. For safety purposes, 7% isopentane was added to the methanol. The experimental engine was operated briefly in Germany and then shipped to Ontario where it was installed in an engine test cell. Emissions were obtained over simulated load cycles. Unfortunately, the particulate emissions of the engine were abnormally high, roughly equivalent to that of a normal diesel engine. This was traced to lubricating oil consumption by the engine, and thus the engine had to be partially rebuilt. Afterwards, the particulate emissions were one order of magnitude lower than that of a regular diesel engine, more in line with what would be expected of a methanol engine. The engine was then installed in a five cubic yard load-haul-dump machine and application was made to operate the machine at a mine. It took some time to resolve the safety issues, during which the machine operated briefly on the surface. It was then operated in the underground mine, with refuelling taking place on the surface. However, the aldehyde emissions of the engine were one order of magnitude higher than had been anticipated from the test results. Therefore, the machine was returned to the surface where it continues to operate. The methanol engine performed quite satisfactorily with no major mechanical or ignition problems during the test period. The cause of the excessive aldehyde emissions could not be found due to lack of time and funds within this contract. 36 figs.

40235 (MEM/CRE—MG11880) Gasohol Fleet Test. Bercuson, N.; Mathers, D.; Bourdon, N.; Kozalk, L. (Manitoba Dept. of Energy and Mines, Winnipeg (Canada). Conservation and Renewable Energy Branch). Mar 1983. 63p. (CE—01511). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

The objective of this study was to assess the feasibility of gasohol as an automotive fuel in Manitoba, by comparing the overall performance and operating costs of a test fleet operating on gasohol with those of a control fleet operating on unleaded gasoline. The performance of gasoline and gasohol was compared by using three specific types of tests, relating to general driveability and relative fleet fuel consumption, operation, specific fuel consumption, and detailed engine operating characteristics. No differences in driveability and overall vehicle performance were apparent between vehicles operating on gasohol and gasoline. No significant difference in specific fuel consumption for the two fleets was indicated. Further analysis indicated that the specific energy consumption of similar vehicles was lower when operated on gasohol than when operated on gasoline. Chassis dynamometer tests, which eliminated the many uncontrolled variables that occur in fleet comparisons, indicated that the specific fuel consumption was significantly less for vehicles operated on gasohol in urban (and highway) driving conditions than for the same vehicles operated on gasoline. In comparative engine dynamometer tests on a conventional 2.3 liter automotive engine, the maximum power output with gasohol was about 7% greater than with gasoline. At maximum load, the brake specific fuel consumption was as much as 10% lower with gasohol than with gasoline. There was no difference in routine engine maintenance requirements for vehicles operated on gasoline or gasohol. Overall test results indicated that gasohol is a viable fuel alternative to gasoline. 25 figs., 2 tabs.

40236 (MEM/CRE—MG11894) Propane Fleet Test. Manitoba Telephone System. Bercuson, N.; Mathers, D.; Bourdon, N.; Kozalk, L. (Manitoba Dept. of Energy and Mines, Winnipeg (Canada). Conservation and Renewable Energy Branch). Mar 1983. 32p. (CE—01512). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

The objective of this study was to assess the feasibility for propane as an automotive fuel in Manitoba, by comparing the overall performance and operating costs of a test fleet operating on propane with that of a control fleet operating on unleaded gasoline. The performance of gasoline and propane was compared by using two specific tests: general driveability and relative fleet fuel consumption were determined by driver surveys and gross fuel use data from normal urban and rural vehicle operation. Specific fuel consumption was determined by controlled chassis dynamometer tests on a series of selected vehicles utilizing representative driving cycles. Fleet drivers operating propane fueled vehicles were satisfied with vehicle operation and reported similar vehicle performance with either gasoline or propane. Although there was no significant difference in specific fuel consumption, the specific energy consumption of similar vehicles was lower when operated on propane, than when operated on gasoline. Chassis dynamometer tests, which eliminated the many uncontrolled variables that occur in fleet comparisons, showed that specific fuel consumption for the propane vehicles was significantly greater than for the gasoline vehicles in both urban and highway driving conditions. Because of the difference in specific fuel costs of the two fuels, however, cost savings occured when using propane. Overall test results indicated that propane is a viable fuel alternative to gasoline. 2 figs., 12 tabs.

40237 (ORF—42281) Development and testing of M100 vehicles for the Canadian market. Final report. Stekar, J.; Goetz, W.A. (Ontario Research Foundation, Sheridan Park (Canada)). 12 May 1983. 64p. (CE—01507). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

A program concentrating on 100% methanol fueled spark ignition engines was initiated with the objective to evaluate cold start performance, engine wear and driveability of vehicles operated under Canadian climatic conditions. The first vehicle involved in this program is a VW Golf, equipped with a 1.6 liter engine which is factory modified for operation on methanol. It was assigned for chassis dynamometer evaluation. A total of about 10,600 kilometres has been accumulated. In order to document the engine condition and establish baseline data for an enigne wear analysis, it was decided that as part of the vehicle preparation, the condition of the engine should be established. This technical report describes the details of the engine disassembly, measurements and results and its assembly and installation in the VW Golf vehicle. An additional task was the development of a detailed work program with the objective of providing systematic information on cold start performance of methanol powered vehicles and identifying the best possible solution(s). A statement of work for this future phase is presented in an appendix. 23 figs., 18 tabs.

40238 (OTC—TEMP86203) Alternative transportation operational plan, 86/87. Topologlu, T. (Ontario Ministry of Transportation and Communications, Ottawa (Canada)). Sep 1986. vp. (MICROLOG—88-01831). Transportation Energy Management Program (TEMP), Central Building, Rm. 324, Ontario Ministry of Transportation and Communications, 1201 Wilson Ave., Downsview, Ont., Canada M3M 1J8; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

The Ontario government has initiated a program to investigate alternative fuel options in order to reduce its dependence on dwindling petroleum resources. The proposed Alternative Transportation Fuels Program includes technology development, applied research, and fleet testing projects. These are organized for five program modules - Propane, Natural Gas, Alcohols, Diesel Substitution, and Automotive Energy General. Within each module the projects are assigned to the Transportation Energy Technology Development and Fuels Research programs according to the purpose of each project. Each project is described by a comprehensive project summary sheet. The projects in the Transportation Energy Technology and Fuel Research Programs have been selected to meet the following objectives: to develop a range of technologies which permit the efficient and increased utilitization of alternative fuels; to demonstrate the use of alternative fuels in the automobile, truck and bus sector; to demonstrate new technologies associated with use of all alternative fuels; to develop new applications for alternative fuels in the marine, rail and agricultural sectors; and to review and assess current fuel and engine technologies.

40239 (PB—88-205828/XAB) Nox control technology data base for gas-fueled prime movers: Phase 1. Topical report, March 1985-September 1986. Thring, R.H.; Hull, R.W.; Ingalls, M.; Urban, C.; Ariga, S. (Southwest Research Inst., San Antonio, TX (USA). Dept. of Engine and Vehicle Research). Apr 1988. 150p. NTIS, PC A07/MF A01.

Phase 1 of a study to expand the performance and life-cycle cost data base for NOx control of gas-fueled prime movers has been accomplished through experimental evaluations of fuel effects, technical literature reviews of Japanese and domestic approaches to NOx control and through direct contacts with manufacturers and users in the United States and Japan. Engine tests confirm literature findings that natural gas and methanol provide an advantage over petroleum fuels in limiting NOx formation. For lean-burn engines (e.g., two-cycle and gas turbine engines), selective catalytic reduction offers the greatest amount of NOx control. Installation, operating and maintenance costs are very high; the method has received moderate acceptance in Japan but limited use in the United States. For rich-burn engines, nonselective catalytic reduction is gaining acceptance for NOx control. This method is basically the adaption of automotive three-way catalyst technology. Further R&D is recommended for alternative methods of NOx control which include combustion-cycle modifications and noncatalytic exhaust aftertreatment.

40240 **(PB—88-206149/XAB) Laboratory testing of alternative diesel fuels.** Hunt, M.S. (Council for Scientific and Industrial Research, Pretoria (South Africa). National Mechanical Engineering Research Inst.). 1986. 17p. (CSIR-ME—517). NTIS, PC E04/MF E04.

North American Continent sales only.

This paper gives the results of some of the recent research work carried out, as part of the National Energy Program, on alternative diesel fuels. After describing the use of the four-ball machine for the laboratory determination of lubricity a comparison is made with the qualitative results obtained from bench tests on diesel-injection pumps. In spite of the generally held view that the correlation between laboratory and engine testing is not good, it is shown that for the particular fuel pumps tested the laboratory measurements give a reasonably clear indication of the performance of the fuels in question during bench tests.

40241 **(PB—88-210604/XAB) Direct injection of high-pressure natural gas in reciprocating engines. Final report, March 1986-August 1987.** Hoppie, L.O.; Haefner, D.R.; Scharnweber, D.H.; Worthen, R.P. (Eaton Corp., Southfield, MI (USA). Engineering and Research Center). Oct 1987. 61p. NTIS, PC A04/MF A01.

See also PB—87-102133.

Combustion of directly injected natural gas was achieved in a single-cylinder version of a Cummins 903 engine by activating some of the compressed gas prior to injection. Activation was achieved by creating a plasma of natural gas within an electronically controlled injector that could be retrofit onto the engine. Emissions of NOx were substantially and consistently less than those of the base diesel engine, but the efficiency was lower because of a relatively long and late heat-release profile. Injection and activation parameters responsible for the lower efficiency are mentioned and several approaches to improve efficiency are discussed. Electrode erosion rates were high and means of reducing erosion are described.

35 ARMS CONTROL

REFER ALSO TO CITATION(S) 39992

3501 Policy, Negotiations, And Legislation

40242 **(AD-A—190925/8/XAB) Demographics and the military balance: NATO in the nineties. Final report.** Clark, S.L. (Institute for Defense Analyses, Alexandria, VA (USA)). Sep 1987. 35p. (IDA-P—2049). NTIS, PC A03/MF A01.

IDA Independent Research Program.

This paper consists of an assessment of the potential impact of impending demographic constraints on the North Atlantic Treaty Organization's military manpower levels. It also examines what policy measures might be adapted in order to alleviate these future manpower shortages. Finally, it estimates how these demographic constraints might affect Western security interests and East-West relations in the area of conventional arms control.

40243 **(AD-A—191519/8/XAB) West European Arms control policy. Final report, December 1986-January 1988.** Laird, R.F. (Institute for Defense Analyses, Alexandria, VA (USA)). Jan 1988. 51p. (IDA-P—2038). NTIS, PC A04/MF A01.

IDA Independent Research Program.

The main focus of this project has been upon the executive decision-making systems in four major European countries, namely the United Kingdom, France, West Germany, and Italy. The focus on arms-control decision making in Western Europe necessitated conducting extensive interviews with a wide range of West European government and opinion elites. Virtually all of the major West European political and administrative officials in the arms-control area have been interviewed at least once and some have been interviewed several times.

3503 Verification

REFER ALSO TO CITATION(S) 41323

36 MATERIALS

REFER ALSO TO CITATION(S) 39548, 40060, 40214, 42499

40244 **(AD-A—191467/0/XAB) Triangularity of the basis in linear programs for material-requirements planning. Technical report.** Ho, J.K.; McKenny, W.A. (Tennessee Univ., Knoxville (USA). Management Science Program). Jun 1987. 16p. (MSP—87-3). NTIS, PC A03/MF A01.

It is shown that the basis in a class of linear programs arising from material-requirements planning can be triangularized. This allows for efficient adaptation of the Simplex Method similar to those for network problems. It also suggests that for finite-loading (i.e., capacitated), MRP, a decomposition approach exploiting both subproblem structure and parallel processing can be effective for handling complex problems in multiproduct, multistage, multiperiod production systems.

40245 **(CONF-871246—3) Dynamical effects in the {open+-quotes}phase change{close+-quotes} behavior of small clusters.** Jellinek, J.; Jasien, P.G. (Argonne National Lab., IL (USA)). 1987. Contract W-31109-ENG-38. 9p. NTIS, PC A02/MF A01;1; GPO Dep. Order Number DE88009976/JAW.

From International workshop on the structure of small molecules and ions; Neve Ilan, Israel (13 Dec 1987).

Results of a detailed dynamical simulation study of a 13-particle Lennard-Jones cluster are presented. They point to the fact that the pattern of the time-evolution of the cluster, and thus its {open+-quotes}phase{close+-quotes} and {open+-quotes}phase change{close+-quotes} properties, depend not only on the total energy of the system but also on its initial state. It is found that the maximal Liapunov number can adequately label the different {open+-quotes}phases{close+-quotes} of a cluster system. 13 refs., 3 figs., 1 tab.

40246 **(DOE/ER/13089—T2) Continuous Damage Theory: Progress report, August 1, 1984-July 31, 1985.** Krajcinovic, D. (Illinois Univ., Chicago (USA)). 1985. Contract AC02-83ER13089. 3p. NTIS, PC A02/MF A01;1; GPO Dep. Order Number DE88012248/JAW.

The research activity related to the development of the Continuum Damage Mechanics (CDM) was directed along three lines of attack. The formulation of a rigorous phenomenological theory, based on a physically acceptable damage measure, was in many ways accomplished. The model is further refined and applied with a remarkable accuracy in duplicating experimentally measured data for brittle materials (rock and concrete) in uniaxial and biaxial tension and compression. Effort was also directed towards the application of CDM to creep of metals and rupture of fiber reinforced concrete. The objective was primarily on exploring utility of the theory in a variety of different problems.

40247 **(ORNL/TM—10601) Metals and Ceramics Division Materials Sciences Program: Annual progress report for period ending June 30, 1987.** Stiegler, J.O. (comp.). (Oak Ridge National Lab., TN (USA)). Apr 1988. Contract AC05-84OR21400. 319p. NTIS, PC A14/MF A01;1; GPO Dep. Order Number DE88008948/JAW.

The program is directed at uncovering principles for the scientific design of materials. The efforts emphasize three classes of materials: high-temperature metallic alloys based on intermetallic compounds, structural ceramics, and radiation-resistant alloys. The first two materials are central to the theme of the High Temperature Materials Laboratory, and the third supports the Laboratory's mission in fission and fusion reactor technology. We combine the use of unique structural characterization facilities, the activities of the Theory Group, and accurate property determination to establish structure-property relationships. An important aspect of the program is the interaction with universities, industry, and other lab-

oratories. Two collaborative research centers established to aid these interactions are SHaRe and ORSOAR, which make our strong structural characterization capabilities available to researchers outside ORNL. Their research activities and capabilities are summarized in Chap. 1, "Structural Characterization," and Chap. 6, "Collaborative Research Centers." Other interactions with the scientific community are summarized in the Appendixes.

3601 Metals And Alloys

REFER ALSO TO CITATION(S) 39052, 39073, 39251, 39387, 39395, 39407, 39527, 39609, 39618, 39645, 39656, 39657, 39663, 39677, 39687, 39687, 39731, 39745, 39750, 39752, 39756, 39789, 39853, 39854, 39854, 40379, 40446, 40486, 40592, 40620, 40621, 40719, 40724, 40762, 40762, 41106, 41752, 42100, 42390

40248 (AD-A—189106/8/XAB) Fatigue corrosion of amorphous Fe(75-X)Cr(X)B(15)Si(10) wires. Technical report. Kabacoff, L.T.; Le, A. (Naval Surface Weapons Center, Silver Spring, MD (USA). White Oak Lab.). Nov 1986. 20p. (NSWC-TR—86-218). NTIS, PC A03/MF A01.

Fatigue and corrosion properties of metallic-glass wires with the composition Fe(75-X)Cr(X)B(15)Si(10) (X = 5, 8, and 10) were measured. Measurements were made in air, water, 3.5 w/o NaCl, and 1 NH_2SO_4. The observed fatigue limits are inversely proportional to the corrosion rate indicating a corrosion fatigue-failure mechanism. Fatigue characteristics of the wires are vastly superior to melt-spun metallic glass ribbons of similar composition, and superior to 304 stainless steel. Yield strengths up to 900 KSI have been observed (for 11 a/o Cr). Under certain circumstances, the wires are self healing in that if the cyclical strain applied to test specimens is interrupted prior to failure and then reapplied, the wire behaves in a manner identical to a new, unfatigued specimen. The corrosion characteristics of the wires are similar to those of melt spun ribbons of similar composition. Pitting and crevice corrosion in chloride environment are very slight or absent.

40249 (AD-A—190417/6/XAB) Thin superconducting-film characterization by surface acoustic waves. Annual progress report 30 September 1986-30 September 1987. Levy, M. (Wisconsin Univ., Madison (USA). Plasma Physics Research). 30 Oct 1987. 15p. NTIS, PC A03/MF A01.

A dilution refrigerator was installed, tested, and modified. Several cryogenic probes were fabricated to measure resistivity, ac susceptibility, and ultrasonic attenuation in high-T superconductors. Ultrasonic-attenuation measurements were performed on single crystals of UPt_3 and URu_2Si_2. A maximum in attenuation was found below the superconducting transition temperature of URu_2Si_2. A magnetic field decreased this maximum. The temperature of the attenuation in the normal and superconducting states below T/sub c/ was measured in UPt_3. The ratio of the attenuation follows a power-law dependence indicative of an anisotropic superconducting energy gap. A peak in attenuation found in the mixed state of UPt_3, which may be associated with a phase transition of the flux-line lattice.

40250 (AD-A—190492/9/XAB) Growth and deformation mechanisms of refractory-alloy hybrid materials. Annual report, 15 September 1986-15 September 1987. Sastry, S.M.; Bowden, D.M.; London, B.D.; Lederich, R.J.; O'Neal, J.E. (McDonnell Douglas Research Labs., St. Louis, MO (USA)). Dec 1987. 38p. (MDC-QA—002). NTIS, PC A03/MF A01.

Oxide-dispersion-strengthened and whisker/particulate reinforced titanium and niobium alloys produced by rapid-solidification processing are being investigated with the objectives of understanding the mechanisms of formation and growth of the secondary phases and how these factors determine strengthening mechanisms and thermal stability of Ti and Nb alloys. During the first year of the three-year program, titanium alloys containing aluminum, erbium, boron, and carbon, and Nb alloys containing tungsten, hafnium, lanthanum, B, and C were prepared by nonconsumbable electrode arc melting and microstructures were characterized. The alloys were rapidly solidified by electron-beam melting and splat quenching and the rapidly solidified flakes were characterized by x-ray diffraction, optical metallography, and electron microscopy. The mechanical properties of rapidly solidified Ti alloys containing Er, B, and C were determined by tensile testing of specimens prepared from electron-beam-melted and splat-quenched flakes.

40251 (AD-A—191274/0/XAB) Laser cladding of Ni, Nb, and Mg alloys for improved environmental resistance at high temperature. Annual progress report, November 1986-October 1987. Mazumder, J. (Illinois Univ., Urbana (USA). Laser Aided Materials Processing Lab.). Oct 1987. 208p. NTIS, PC A10/MF A01.

This report summarizes experimental and theoretical studies carried out during the period of Nov 1986 to Oct 1987 on laser cladding of Ni and Nb alloys for improved environmental resistance at high temperature. Major emphasis has been on Ni-Cr-Al-Hf system. Microstructural evolution and oxidation properties of these alloys were examined. For Nb alloys microstructural characterization and differential thermal analysis were carried out. A one-dimensional diffusion model for finite domain to examine the extended solid solubility in laser cladding was also developed.

40252 (AD-A—191460/5/XAB) Effect of extended solid solution of Hf on the microstructure of the laser clad Ni-Fe-Cr-Al-Hf alloys. Singh, J.; Mazumder, J. (Illinois Univ., Urbana (USA). Laser Aided Materials Processing Lab.). 1987. 14p. NTIS, PC A03/MF A01.

Pub. in Acta Metallurgica, Vol. 35, No. 8, 1995-2003(1987).

Alloys and coatings for alloys for improved high-temperature service life under aggressive atmospheres are of great contemporary interest. There is a general consensus that addition of reactive elements such as Hf will provide many beneficial effects for such alloys. The laser cladding technique was used to produce Ni-Fe-Cr-Al-Hf alloys with extended solid solution of Hf. A 10-kW CO_2 laser with mixed powder feed was used for laser cladding. Optical, scanning electron (SEM) and scanning transmission electron (STEM) microscopy were employed for microstructural evolution of alloys produced during laser-cladding processes. The electron probe microanalysis and the Auger electron spectroscopy were also used for microchemical analysis of different phases. Microstructural studies revealed a high degree of grain refinement, considerable increase in solubility of Hf in matrix, and Hf-rich precipitates and new metastable phases. This paper reports the microstructural development in this laser-clad Ni-Fe-Cr-Al-Hf alloy.

40253 (CONF-880314—3) Materials performance in simulated FBC [fluidized-bed combustion] environments. Natesan, K.; Podolski, W.F. (Argonne National Lab., IL (USA)). Sep 1987. Contract W-31109-ENG-38. 33p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88010035/JAW.

From Corrosion '88: National Association of Corrosion Engineers meeting; St. Louis, MO, USA (21 Mar 1988).

The US DOE-sponsored Atmospheric Fluidized-Bed Cogeneration Air Heater Experiment (ACAHE) is intended to assess the performance of various heat exchanger materials in order to establish confidence in the resultant designs of fluidized-bed combustion (FBC) air heater systems. Westinghouse Electric Corporation is preparing specifications and hardware for the ACAHE. Argonne National Laboratory (ANL) will conduct the tests. A laboratory test program is in progress to evaluate the corrosion behavior of several metallic alloys, coatings, claddings, and weldments in support of the ACAHE experiment. Results are presented from two tests of 3000-h duration each conducted at metal and gas temperatures of 871 and 899{degree}C, respectively. Detailed information is also presented on the corrosion scale morphologies, scale compositions and thicknesses, intergranular penetration of the substrate material, and metal recession. These tests have provided corrosion information on a variety of ASME-coded and noncoded structural materials under a well-characterized laboratory test environment simulating the atmospheres in bubbling and circulating bed combustors. 4 refs., 15 figs., 4 tabs.

40254 (CONF-880488—4) Oxidation-erosion of metals and alloys: Models, verification, and prediction. Liu, Yung Y.; Natesan, K. (Argonne National Lab., IL (USA)). Jan 1988. Contract W-31109-ENG-38. 23p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88010016/JAW.

From 15. international conference on metallurgical coatings; San Diego, CA, USA (11 Apr 1988).

Models have been developed for synergistic interaction of oxidation and erosion of metals and alloys. The models are based on an extension of earlier work on paralinear kinetics in which oxidation of metal is assumed to be diffusion controlled, and erosion is assumed to result in a uniform removal of materials. Predictions of oxidaion-erosion behavior as a function of temperature and erosion conditions have been made for several chromia- and alumina-forming alloys, which included the construction of two master plots for these alloys that allow distinction of oxidation- or erosion-demonited regime as a function of the kinetic rate constants. The models have also provided reasonable explanations of the results obtained in the oxidation-erosion experiments on pure nickel and cobalt. 14 refs., 5 figs.

40255 **(CONF-8702142—1) Application of auger electron spectroscopy to the study of trace element effects on weldability.** White, C.L.; David, S.A.; Richey, M.W. (Michigan Technological Univ., Houghton (USA). Dept. of Metallurgical Engineering; Oak Ridge National Lab., TN (USA); Oak Ridge Y-12 Plant, TN (USA)). 1987. Contract AC05-84OR21400. 14p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88010457/JAW.

From International symposium on welding metallurgy of structural steels; Denver, CO, USA (22 Feb 1987).

In this paper, we briefly overview the application of AES (auger electron spectroscopy) to the study of impurity segregation in weld cracking problems. Although these impurities have long been implicated in weld cracking, AES results thus far are not sufficiently extensive to demonstrate a clear correlation between their segregation, and the severity of weld cracking. 12 refs., 8 figs.

40256 **(CONF-8805134—3) Thin film and near-surface characterization using a mechanical properties microprobe.** Oliver, W.C.; McHargue, C.J. (Oak Ridge National Lab., TN (USA)). 1988. Contract AC05-84OR21400. 6p. NTIS, PC A02/MF A01;1; GPO Dep. Order Number DE88011399/JAW.

From Ion implantation and plasma assisted processes for industrial applications conference; Atlanta, GA, USA (21 May 1988).

Ion implantation of materials to improve their mechanical properties is a rapidly expanding industry. Such surface treatments result in very thin (<500 nm) surface films. These films can have extraordinary mechanical properties due to the tremendous variety of structures and compositions available via ion implantation. The mechanical properties microprobe (MPM) has been developed to determine the properties of such thin films. In this paper we will discuss the application of the MPM to several ion implanted material systems. 19 refs., 8 figs.

40257 **(DOE/ER/10963—5) An x-ray diffraction and TEM [transmission electron microscopy] study of subsurface recovery during abrasion.** Rao, C.M.; Kosel, T.H. (Notre Dame Univ., IN (USA). Dept. of Metallurgical Engineering and Materials Science). 1985. Contract AC02-81ER10963. 10p. (CONF-850415—7). NTIS, PC A02/MF A01;1; GPO Dep. Order Number DE88008355/JAW.

From 4. international conference on wear of materials; Vancouver, Canada (14 Apr 1985).

The subsurface dislocation structures and the extent of dynamic recovery and recrystallization in pure metals subjected to low-stress abrasion have been examined. Pure copper and aluminum were chosen to provide a range of melting and therefore recrystallization temperatures. The materials were strain annealed before abrasion in order to produce extremely large initial grain sizes. Back-reflection x-ray pinhole photographs of the original specimens produced single crystal Laue patterns, whereas the abraded specimens produced Debye rings. In the case of aluminum the Debye rings contained distinct individual spots, whereas the copper produced smooth, continuous rings. Transmission electron microscopy (TEM) was used to examine subsurface sections parallel to the war tracks to provide more direct evidence of the subsurface microstructural changes. In all cases, at greater depths below the worn surface, the materials showed dislocation cells typical of a high degree of room temperature deformation, with the degree of deformation decreasing with depth. Closer to the surface, the copper exhibited a fine, high-misorientations subgrain structure which is believed to be responsible for the continuous Debye rings seen in the x-ray pattern. In the case of aluminum, there appeared to be a mixture of fine subgrains and larger dynamically recrystallized grains which are believed to have produced the spotty Debye rings. 29 refs., 14 figs.

40258 **(DOE/ER/45138—T3) Corrosion fatigue of small cracks: Mechanics and chemistry: Final technical report for period July 1, 1984 to October 31, 1987.** Wei, R.P. (Lehigh Univ., Bethlehem, PA (USA). Dept. of Mechanical Engineering and Mechanics). 7 Mar 1988. Contract FG02-84ER45138. 10p. NTIS, PC A02/MF A01;1; GPO Dep. Order Number TI88012121/JAW.

The proposed research was designed to address certain fundamental issues relating to the growth of small cracks in corrosion fatigue, and utilized the unique approach and capabilities developed at Lehigh University. Electro-chemical reaction control of corrosion fatigue crack growth in ferrous alloys was demonstrated. The controlling reactions are those involving equilibration of the crack-tip bare surfaces with its neighboring filmed or oxidized surfaces. Electrolyte within the crack serves as a high resistance path that separates the crack tip region from the bulk (external) environment. Because of this high resistance, the crack tip region is effectively shielded and the reactions are affected little by the externally imposed conditions, with the crack-tip potential tending to remain very near the free corrosion potential. With increases in test temperature, it becomes increasingly difficult to displace the crack-tip potential away from the free corrosion potential.

40259 **(DOE/ER/45273—2) [Monitoring interfacial dynamics by pulsed laser techniques]: [Annual report].** Richmond, G.L. (Oregon Univ., Eugene (USA)). [1988]. Contract FG06-86ER45273. 6p. NTIS, PC A02/MF A01;1; GPO Dep. Order Number DE88009669/JAW.

Our approach in these studies is to use Second Harmonic Generation (SHG) to monitor the response of the system at a known time delay following a fast perturbation such as a voltage pulse or photoexcitation. In the first experiments of this kind, we reported the success in performing these experiments using a 10 ns, 10 Hz YAG laser. By monitoring the SH light generated by the IR laser pulse at numerous delays after a potential step, we captured the complete transient response of the charging of the double layer after the perturbation. One drawback to these studies was that it took several hours to capture a single decay curves since each delay point required signal averaging at a repetition rate of 0.03 Hz. We alleviated this problem by setting up a 76 Hz, 100 psec YAG laser with photon counting equipment which enabled us to continuously monitor the SHG response to the applied voltage step. The adsorption and desorption of specifically and nonspecifically adsorbed anions on polycrystalline Ag electrodes biased within the limits of the ideally polarizable region ({minus}1.2 V to {minus}0.1 V vs. Ag/AgCl) was begun. The results demonstrate the utility of fast pulsed laser light as a continuous monitor of surface dynamics on the millisecond timescale using this time resolved SHG method. 5 refs.

40260 **(DOE/NASA—0234-1) Cast iron-base alloy for cylinder/regenerator housing: Final report.** Witter, S.L.; Simmons, H.E.; Woulds, M.J. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). Aug 1985. Contract AI01-85CE50112. 140p. (NASA-CR—182116). NTIS, PC A07/MF A01;1; GPO Dep. Order Number DE88008586/JAW.

The objective is to develop an Fe-base alloy that can meet the requirements of the automotive Stirling engine cylinders and regenerator housings. The scope of work was to test various alloys and select the one best demonstrating the following characteristics: It must be a cast alloy, using nonstrategic metals. It must withstand stresses for a 2500-hr rupture life at 200 MPa/775{degree}C. Oxidation/corrosion resistance must be comparable to that of N-155. It must be compatible with hydrogen. Fatigue properties must be superior to alloy XF 818. Cost must be less than or equal to that of 19-9DL. Major tests were designed to include the following: Selection, processing, and evaluation of candidate alloys within each

alloy group system. Determination of casting parameters. Selection of a candidate alloy and establishment of a data base for this alloy. In the initial phase of the program designated as Round 1, a series of alloys representing each alloy system was cast and tested. In all there were 5 alloys of the nickel-manganese Group 1, 13 alloys of the nickel Group 2, and 3 alloys of the manganese Group 3. The aim was to maintain the chemistry of the major element(s) shown and vary the percentage of other elements to study their influence. Evaluation of results obtained from this series of tests enabled us to closely define the chemistry range for our candidate alloy, designated NASACC-1. A master heat was made to this composition. The heat was melted and poured under controlled casting conditions previously established and poured into investment shell molds. All castings and test bars were heat treated before actual testing. NASACC-1 proved to be an excellent alloy for casting. It could be melted in air and had good fluidity and fill characteristics. The alloy met or exceeded all program goals. 28 refs., 47 figs., 44 tabs.

40261 **(DOE/NE—37963-2) Deformation induced microstructural and microchemical changes during thermomechanical treatment: Quarterly progress report, January-March 1987.** Bruemmer, S.M.; Atteridge, D.G.; Murr, L.E.; Wood, W.E. (Oregon Graduate Center, Beaverton (USA)). 31 Mar 1987. Contract AC06-86NE37963. 15p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88012981/JAW.

Thermomechanical effects on the stress corrosion cracking of austenitic stainless steel-316 and Inconel 600 will be studied because of their critical importance in energy-production systems and the limitations in current understanding to model and predict microstructural and microchemical development. Program components will include detailed examination of temperature and stress effects on grain boundary structural defects, precipitate nucleation and growth, and redistribution of alloying and impurity elements. Practical applications of this data will be evolved through the characterization and simulation of thermochemical histories developed during material processing, fabrication and service, and the direct correlation of grain boundary microstructure and microchemistry to SCC resistance. 3 figs., 2 tabs.

40262 **(DOE/NE/37963—1) Deformation induced microstructural and microchemical changes during thermomechanical treatment: Quarterly progress report, October-December 1986.** Bruemmer, S.M.; Atteridge, D.G.; Murr, L.E.; Wood, W.E. (Oregon Graduate Center, Beaverton (USA)). 1986. Contract AC06-86NE37963. 8p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88012982/JAW.

This research will develop a basic understanding and a methodology to predict the effects of a material's processing, fabrication and service history on its resistance to low-ductility failure. Basic and applied materials engineering components will be intergrated to attain both mechanistic understanding and applications-oriented modeling during the program. Thermomechanical effects on the stress corrosion cracking of austenitic stainless steel 316 and Inconel 600 will be studied because of their critical importance in energy-production systems and the limitations in current understanding to model and predict microstructural and microchemical development. Program components will include detailed examination of temperature and strain effects on grain boundary structural defects, precipitate nucleation and growth, and redistribution of alloying and impurity elements.

40263 **(DOE/NE/37963—3) Deformation induced microstructural and microchemical changes during thermomechanical treatment: Quarterly progress report, April-June 1987.** Bruemmer, S.M.; Atteridge, D.G.; Murr, L.E.; Wood, W.E. (Oregon Graduate Center, Beaverton (USA)). 28 Jul 1987. Contract AC06-86NE37963. 38p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88012983/JAW.

This research will develop a basic understanding and a methodology to predict the effects of a material's processing, fabrication and service history on its resistance components will be integrated to attain both mechanistic understanding and applications-oriented modeling during the program. Thermomechanical effects on the stress corrosion cracking of austenitic stainless steel 316 and Inconel 600 will be studied because of their limitations in current understanding to model and predict microstructural and microchemical development. Program components will include detailed examination of temperature and strain effects on grain boundary structural defects, precipitate nucleation and growth, and redistribution of alloying and impurity elements. 13 figs., 4 tabs.,

40264 **(DOE/PC/80524—T10) Pipe and bend erosion by pneumatic transport of solids at high temperature: Quarterly report, October-December 1987.** Klinzing, G.E. (Pittsburgh Univ., PA (USA). Dept. of Chemical and Petroleum Engineering). 1987. Contract FG22-85PC80524. 20p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88010418/JAW.

In this report the analysis of erosion data by coal slag is presented and compared with the results of sand erosion. While effects of gas velocity and solids concentration are similar in both cases, the effect of temperature on the erosion rate was radically different for each material. The experimental efforts during this period focused on the effect of roughness and temperature on the pressure drop in the vertical test section. The pressure drop data show that temperature effects are minimum while pipe roughness plays a more significant role. The effect of temperature and roughness on the pressure drop of air alone is well predicted by the correlations available in literature. But when soilds are circulating, the agreement between existing correlations and experimental data is poor, becoming worse as the roughness increases. 5 refs., 10 figs. 2 tabs.

40265 **(EPRI-NP—5761M) Stress corrosion cracking of alloys 600 and 690 in all-volatile-treated water at elevated temperatures: Final report.** Miglin, B.P.; Theus, G.J. (Electric Power Research Inst., Palo Alto, CA (USA)). May 1988. 18p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88010461/JAW.

This report describes stress corrosion (SCC) tests of Inconel alloys 600 and 690 in all-volatile treated (AVT) water. Specimens of alloys 600 and 690 were exposed to AVT water at 288{degree}, 332{degree}, 343{degree}, and 360{degree}C. Alloy 660 generally resists SCC in high-purity water at normal sevice temperatures, but is susceptible to SCC at higher temperatures. In general, mill-annealed alloy 600 is more susceptible than high-treated material with fine lacy grain boundary carbides. Very high stresses (near or above yield) are required to induce cracking of alloy 600 in AVT or other high-purity waters. For alloy 600, 78 of 520 alloy 600 specimens eventually cracked. Although exposed for less total time than alloy 600 specimens, no alloy 690 specimens cracked. Three alloy 600 specimens cracked in the same autoclave tests in less time than those accumulated by the alloy 690 specimens. Longitudinally-oriented ID cracks became evident on alloy 690 split-tube U-bend specimens after autoclave exposures. These cracks on the 690 specimens were from three to ten times longer after exposure than similar defects found on unexposed alloy 690 specimens. The longitudinal crack lengthening on the alloy 690 split-tube U-bend specimens may have been a stress relaxation process or possibly a crack opening process of pre-existing, partially closed, longitudinal defects. Similar cracks were present in alloy 600 specimens, but in at least one case SCC did initiate from these shallow, blunt cracks.

40266 **(EPRI-NP—5800M) Hydrogen water chemistry to mitigate intergranular stress corrosion cracking: In-reactor tests: Final report.** Ljungberg, L.G.; Lejon, J.; Rebensdorff, B. (ASEA-ATOM AB, Vaesteraas (Sweden)). May 1988. 72p. Research Reports Center, Box 50490, Palo Alto, CA 94303;1. Order Number TI88010465/JAW.

In-reactor studies of intergranular stress corrosion cracking (IGSCC) in sensitized Type 304 stainless steel were performed during operation under hydrogen water chemistry (HWC) in the Swedish Ringhals-1 BWR. Techniques used were constant elongation rate tensile (CERT) tests and corrosion potential (ECP) measurements. Objective of the tests was to identify and investigate factors other than oxygen concentration in the water, which affect IGSCC. Results show that hydrogen peroxide and sulfate in the water severely enhance IGSCC, and thus need to be controlled to fully mitigate IGSCC by HWC. Hydrogen in recirculation water was mildly beneficial, and nitrate was fairly harmless. HWC arrests existing IGSCC cracks, but if HWC is stopped the cracks eventual-

ly become reactivated. No difference in IGSCC propensity was found between unfilmed steel and steel prefilmed in the HWC environment for eight weeks. 40 refs., 16 figs., 13 tabs.

40267 **(EPRI-NP—5874) Laboratory evaluations of iron-based hard-facing alloys: A European study: Final report.** Hofmann, P.J.; Friedrich, B.C. (Electric Power Research Inst., Palo Alto, CA (USA); Siemens A.G., Erlangen (Germany, F.R.)). Jun 1988. 138p. Unlimited audience, publicly available. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88012899/JAW.

In order to identify suitable alternative materials for cobalt-base alloys used as hardfacing material for nuclear valves, three corrosion and wear-resistant iron-base alloys were investigated. In detail, comparisons were performed between Everit 50, Antinit DUR 300, Cenium Z 20 and Stellite 6 as to metallurgy, manufacturing properties, corrosive properties in simulated PWR and BWR coolant (under no-flow and high-flow conditions with and without contamination), tribological properties (at different temperatures, contact pressure levels and for different material combinations) and mechanical properties. Data are given on suitable heat treatment, welding parameters and areas of application for each alloy under consideration. 24 refs., 87 figs., 4 tabs.

40268 (ESA-SP—279, pp vp) **Ball bearings with chemical vapor deposition (CVD)-TiC coated components.** Boving, H.; Hintermann, H.E.; Haenni, W. Dec 1987. NTIS, PC A14/MF A01. (ETN—88-91973; CONF-8709305—).

From 3. European space mechanisms and tribology symposium; Madrid, Spain (30 Sep 1987).

Metallurgical and geometrical aspects of high precision TiC coated AISI 440C steel balls are presented. The chemical vapor deposition process used to produce the coating provides a good metallurgical bond with the substrate and hence a good adherence. Due to its elevated hardness and its fine-grained microstructure, the TiC coating can be polished to produce high precision balls with specifications better than those corresponding to Grade 3 AFBMA. The TiC has favorable friction properties with respect to steel. These advantages of TiC-coated balls make their use in ball bearings attractive. The TiC-coated balls can increase the performance of oil/grease-lubricated, and oil/grease-free bearings in a wide variety of environments, ranging from normal air to space conditions, at temperatures commonly encountered in aerospace applications.

40269 **(EUR—10950) Austin: austenitic steel irradiation E 145-02 Irradiation Report.** Genet, F.; Konrad, J. (Commission of the European Communities, Luxembourg). 1987. 36p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88752437/JAW.

Safety measures for nuclear reactors require that the energy which might be liberated in a reactor core during an accident should be contained within the reactor pressure vessel, even after very long irradiation periods. Hence the need to know the mechanical properties at high deformation velocity of structure materials that have received irradiation damage due to their utilization. The stainless steels used in the structures of reactors undergo damage by both thermal and fast neutrons, causing important changes in the mechanical properties of these materials. Various austenitic steels available as structural materials were irradiated or are under irradiation in various reactors in order to study the evolution of the mechanical properties at high deformation velocity as a function of the irradiation damage rate. The experiment called AUSTIN (AUstenitic STeel IrradiatioN) 02 was performed by the JRC Petten Establishment on behalf of Ispra in support of the reactor safety programme.

40270 **(EUR—11039) Atmospheric corrosion testing of energy conversion coatings: A scientific basis for modification of the DIN 50018 standard.** Straetmans, R.; Bogaerts, W.; Van Haute, A. (Commission of the European Communities, Ispra (Italy). Joint Research Centre; Louvain Univ. (Belgium)). 1987. 74p. NTIS (US Sales Only), PC A04. Order Number DE88012639/JAW.

The present report gives a survey of the effect of some important factors in the SO_2-accelerated atmospheric corrosion process. It also documents the influence of different experimental variables in the DIN 50018 testing procedure. The results contained in this report should provide a scientific basis for a modification of the DIN 50018 standard. This modification should make it more suitable for atmospheric corrosion testing of various solar energy conversion systems and materials. 53 refs., 37 figs.

40271 **(EUR—11265) Comparison of experimental techniques for measuring fracture toughness of austenitic stainless steels by performance of a comparative round-robin test.** Huthmann, H.; Akhurst, K.N.; Bethmont, M.; Fossati, C.; Picker, C.; Ragazzoni, S.; Rongen, H.J.M. van; Soulat, P. (Commission of the European Communities, Luxembourg). 1987. 98p. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88753957/JAW.

The CEC fast breeder coordinating committee, activities group 3 Materials of the working group for codes and standards, has recently examined existing data on the fracture toughness of austenitic stainless steels. As a result, the committee decided to sponsor a round robin test programme aimed at comparing experimental techniques and assisting in establishjng a standard test method for these steels. The contract for this programme was placed with Interatom, who have subcontracted with CEA-Saclay, CEGB-Leatherhead, TNO-Apeldoorn and UKAEA-Risley. Additionally CISE/ENEL-Milano and EdF-Les Renardieres took part in the round robin. This final report presents a common evaluation and discussion of the results gained by the different laboratories.

40272 **(FhG-IWM-W—4/87) Study of the components of the energy-momentum tensor in the vicinity of crack tips under specific material and load conditions.** Siegele, S. (Fraunhofer-Institut fuer Werkstoffmechanik, Freiburg im Breisgau (Germany, F.R.)). Mar 1987. 128p. (In German). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88753787/JAW.

The study examines whether the energy-momentum tensor can be used as a local load parameter, and for this purpose the tensor is determined from the near-field solution for simple, flat structures. The numerical results of two-dimensional structures, for which there exist self-contained near-field solutions, are compared with the results of the above analytical method, and are verified for accuracy. The relevant calculations for two- and three-dimensional structures are compared. (orig./HP) With 2 tabs., 56 figs., 36 refs.

40273 **(FRADOC—15-4) Electron beam welding of heavy thicknesses with a 200 KW gun.** Binard, J.; Ducrot, A. (Societe Franco-Americaine de Constructions Atomiques (FRAMATOME), 92 - Courbevoie (France)). Sep 1986. 10p. (CONF-8609101—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88752426/JAW.

From International conference on power beam technology; Brighton, UK (10 Sep 1986).

In this report, we describe our 200 kW gun, 100 m/sup 3/ vacuum chamber E B welding equipment, implemented since 1985 to increase the process development in the heavy mechanics; to score the goal, we study the influence of parameters as: welding positions, chemical analysis of the material and workpiece thickness. Simultaneously, we carry out welding tests of branch pipes or nozzles on tubes and shells. Some results are shown and good mechanical properties are obtained on thicknesses up to 300 mm.

40274 **(GKSS—87/E/46) Environmental effect on crack propagation at constant displacement rates.** Dietzel, W.; Schwalbe, K.H. (GKSS-Forschungszentrum Geesthacht G.m.b.H., Geesthacht-Tesperhude (Germany, F.R.). Inst. fuer Werkstofforschung). (GKSS-Forschungszentrum Geesthacht G.m.b.H., Geesthacht-Tesperhude (Germany, F.R.)). 1987. 63p. (In German). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88754008/JAW.

The stress corrosion cracking of two aluminium alloys (Al 2024, Al 7075) and of two steels (20MnMoNi55, N-A-Xtra 70) was investigated using three different testing techniques, i.e. constant load, constant displacement, and constant displacement rate and precracked CT- and DCB-specimens, respectively. Especially the tests at constant displacement rates (with displacement rates down to 0.1 μm/h) required the development of suitable measuring and

controlling systems and procedures. Additionally, facilities for testing under ultrahigh vacuum conditions as a reference environment were established. (orig.) With 18 figs., 2 tabs.

40275 (IAE—4436/9) **Dislocation model of fracture.** Kull', L.M. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1987. 24p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703139/JAW.

Papers dealing with study on mechanisms of submicricrack formation and propagation using dislocation representations are analyzed. Cases of brittle and ductile fracture of materials as well as models of dislocationless (amorphous) zone at the growing crack tip are considered. Dislocation models of fracture may be used when studying the processes of deformation and accumulation of damages in elements of nuclear facilities. 35 refs.; 18 figs.; 1 tab.

40276 (IC—87/257) **Pair potential trend of alkali metals under external pressure.** Rahman, S.M.M. (International Centre for Theoretical Physics, Trieste (Italy)). Sep 1987. 18p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702973/JAW.

Structural phase stability of certain alkali metals under external pressure is investigated by looking at their pair potential trend. The effective pair potentials occurring in the real space representation of the band structure contribution relevant to a second-order theory are calculated by using an appropriate dielectric function and a simple empty-core pseudopotential. The relative positions of the neighbouring atoms with respect to the minima in the pair potentials uphold a qualitative picture of the phase stability in these systems. (author). 14 refs, 3 figs, 3 tabs.

40277 (IC—87/365) **Temperature dependence of entropies and specific heats of liquid Na and K.** Joarder, R.N.; Rahman, S.M.M. (International Centre for Theoretical Physics, Trieste (Italy)). Nov 1987. 22p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702986/JAW.

We have investigated the temperature variation of the entropies and specific heats of liquid Na and K. The systems are primarily modelled with a hard sphere (hs) description, but contributions arising from the soft forces and electronic part are also included with the basic hs model. The hard sphere ingredients at various temperatures are determined through the consideration that the difference between the relevant pair potential and its minimum value is just equal to the kinetic energy of a free particle. The basic ingredients thus obtained are employed to calculate the entropies and specific heats of the systems at various temperatures. The calculated values are found to be in good agreement with experiments. (author). 13 refs, 3 figs, 4 tabs.

40278 (INIS-mf—11756) **Radiochemical determination of corrosion of materials exposed to plutonium-bearing solutions as found in practice. Final report.** Marx, G.; Bestanpouri, A.; Droste, R.; Schoenemann, W.; Wegen, D. (Freie Univ. Berlin (Germany, F.R.). Abt. fuer Radiochemie). Jun 1987. 166p. (In German). NTIS (US Sales Only), PC A08/MF A01. Order Number DE88754023/JAW.

The corrosion resistance of metals used for valves (stainless steel 1.4306 N, Hf, Ti, Zr, Ta) was to be examined with a view to their applicability in solutions of the PUREX process, especially in a plutonium-bearing environment. The radioisotope method used for determining the corrosion-induced material reactions is a combination of neutron activation analysis and conventional electrochemical methods. The measuring equipment also includes an impedance measuring device for also determining the thickness of the oxide layer. Potentiostatic and potentiodynamic measurements have been made in solutions that comply with conditions in practice, with temperatures being varied. Under anodic and under cathodic conditions, the annual corrosive abrasion rates are found to be very low (up to about 50 μm.a/sup -1/), but are slightly increasing with higher temperature and HNO/sub 3/ concentration. Plutonium addition enhances the corrosion resistance, and addition of UO/sub 2/ (NO/sub 3/)/sub 2/ revealed no effect on Hf corrosion; halide ions are found to have a significant effect. Comparative assessment of all the metals studied reveals corrosion resistance to decline in the following order: Ta > Hf > Ti > Zr. The contact potentials of the valve metals with stainless steel 1.4306 N remain in the passive range of the latter, with corrosive rates of μm.a/sup -1/, and thus are of no relevance in practice.

40279 (INIS-SU—443, pp 9-13) **Determination of location of chromium atoms displaced from crystal lattice sites in the result of radiation damage.** Artsimovich, M.V.; Mogil'nik, I.F. (AN Ukrainskoj SSR, Kiev. Inst. Yadernykh Issledovanij). 1987. (In Russian). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88780079/JAW.

Voprosy Atomnoj Nauki i Tekhniki.;No. 2.

In Physics of radiation damages and radiation science of materials.

The α-particle (2.2 MeV) channeling method has been applied to investigate radiation damage of Cr-1.5 at % V-0.1 at % Ta monocrystals irradiated in the non-oriented state by α-particles of the same energy up to the {similar←to} 10/sup 18/ cm/sup -2/ dose ({similar←to} 5-10/sup 13/ cm/sup -2/xs/sup -1/ flux density, T≅300 K). Increase in crystalline structure disordering with the dose growth is practically linear and comparatively small. Both the results of classical and quantum-mechanical channeling description are used for experimental data analysis. It is established that the dumbbell <110> is the primary configuration of chromium interstitial atoms. The results obtained can be used when estimating the possibilities of α-particle channeling method application for chromium monocrystal investigation.

40280 (INIS-SU—443, pp 65-76) **Influence of microstructural heterogeneities and gaseous impurity on physicochemical properties of stainless steels.** Platonov, P.A.; Tursunov, I.E.; Levit, V.I. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1987. (In Russian). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88780079/JAW.

Voprosy Atomnoj Nauki i Tekhniki.;No. 2.

In Physics of radiation damages and radiation science of materials.

Chnages in mechanical and physicochemical properties of stainless steel as a result of hydrogen and microstructural heterogeneity (MH) interaction have been investigated. Hydrogen effect on steel samples preheated at different temperatures from room one to 800 deg C has been estimated by the embrittlement degree, by changes in the fracture mode, and in residual electric resistance (RER), by the electron microscopic investigation, by degassing kinetics at linear heating and by the hydrogen role during intercrystalline corrosion (ICC). It is shown that the stainless (sensibilized) steel aged at T/sub 0/=650 deg C is subjected to increased hydrogen embrittlement, when fracture mode changes from the ductile for intercrystalline one. Hydrogen interaction with grain boundary precipitations without using external stress leads to formation of stable defects (interphase microcracks) causing anomalous growth of RER. Hydrogen yield accelerates in steel samples aged at T/sub 0/=400 deg C in comparison with the initial samples, and decelerates in steels aged at T/sub 0/=650 deg C. The supposition on the relation between hydrogen yield acceleration and the increase of hydrogen grain boundary diffusion, and deceleration - with its delay in microcracks, has been made. This supposition is confirmed by gas release calculations based on the kinetic balance equations.

40281 (JAERI-M—88-066) **Effect of heat treatment temperature on creep properties of Hastelloy XR.** Kurata, Yuji; Ogawa, Yutaka; Nakajima, Hajime. (Japan Atomic Energy Research Inst., Tokyo). Mar 1988. 21p. (In Japanese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88754130/JAW.

Effect of heat treatment temperature on creep properties was studied for Hastelloy XR and XR-II developed as heat resistant alloys for high temperature gas cooled reactors. The effect of heat treatment temperature was divided into that of grain size and that of solution treatment. Each effect could be examined separately by using specimens after a two-stage heat treatment. Although creep rupture time and steady-state creep rate at 700 deg C depended on only solution treatment, those at 900 deg C depended on both grain size and solution treatment. It was estimated that influences of

about +- 20 % on creep rupture time were given in the case of short-term creep rupture tests at 900 deg C if there were differences of +- 15 deg C among heat treatment temperatures of materials.

40282 (JINR—R-7-86-322, pp 87) **Alloying effect on the vanadium behaviour.** Didyk, A.Yu.; Malinovskij, V.; Skuratov, V.A. 1986. (In Russian). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88780065/JAW.

In Heavy ion physics - 1985. Collection of annotations of the Nuclear Reaction Laboratory of the Joint Nuclear Research Institute works, 1985.

40283 **(Juel—2164) Investigation of radiation-induced interstitial-impurity-complexes in dilute Ag- and Fe-alloys.** Boerner, C. (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Festkoerperforschung; Technische Hochschule Aachen (Germany, F.R.)). Nov 1987. 104p. (In German). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88753825/JAW.

The aim of the present investigation is the nature of radiation-induced interstitial-impurity complexes in dilute Ag- and Fe alloys. Internal friction is measured for low temperatures and recovery during annealing is observed. In AgAl and AgZn no maxima of internal friction are found, whereas AgCu shows two maxima. In AgAu and AgPt there were no maxima, and in FeNi 3 relaxation processes were found, whereas FeSb showed no maxima. (BHO)

40284 **(Juel-Spez—399) Effects of specimen geometry on fatigue crack growth in X 10 NiCrAlTi 32 20 und NiCr 22 Co 12 Mo.** Pfaffelhuber, M.; Roedig, M.; Schubert, F.; Nickel, H. (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Reaktorwerkstoffe). May 1987. 80p. (In German). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88754177/JAW.

In order to assess the applicability of results obtained with 1"CT specimens, on fracture mechanical parameters of fatigue crack growth at 700/sup 0/C and 850/sup 0/C (and also in some tests at room temperature), the highly heat resistant alloys X 10 NiCrAlTi 32 20 (INCOLOY 800 H) and NiCr 22 Co 12 Mo (INCONEL 617) have been chosen for further experiments. The specimen geometries are CT 1", CT 1/2", and CCP 1/2", and thick-walled pipes with circumferential defect at outer surface. The loads applied are of the pulsating tensile stress type (R = 0.05), at a frequency of 5Hz. Results reveal that at all temperatures, the fatigue crack growth is independent of specimen geometries, so that the linear-elastic ΔK/sub I/-concept is suitable for describing the crack growth under cyclic load.

40285 (KFK—4100, pp 4200/1-4200/8) **Oxidation behaviour of Zircaloy cladding tubes.** Leistikow, S.; Schanz, G. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Material- und Festkoerperforschung 2 - Teilinstitut Huell- und Strukturmaterialien). Sep 1987. (In German). NTIS (US Sales Only), PC A16/MF A01. Order Number DE88754024/JAW.

In Nuclear Safety Project. Annual report 1986.

Parameter studies towards the influence of reduced steam supply rate and of hydrogen addition to steam on the oxidation kinetics and the mechanical behaviour of Zircaloy-4, experimental investigations of the oxidation behaviour and the hydrogen uptake of Zircaloy-4 under mixed atmospheres of steam, hydrogen, and argon at 1100 to 1300/sup 0/C and comparative evaluation of results within the 800 and 1300/sup 0/C temperature range has been completed.

40286 (KFK—4100, pp 4200/56-4200/78) **Oxidation behaviour of stainless steel cladding tubes in steam.** Leistikow, S.; Berg, H. v.; Schanz, G. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Material- und Festkoerperforschung 2 - Teilinstitut Huell- und Strukturmaterialien). Sep 1987. (In German). NTIS (US Sales Only), PC A16/MF A01. Order Number DE88754024/JAW.

In Nuclear Safety Project. Annual report 1986.

A series of isothermal-isobaric stress rupture experiments (950-1200/sup 0/C, 1-50 mm ≅ 100-10 bar) have been performed in steam and argon using internally pressurized tube capsules of the austenitic CrNi-steel DIN No. 1.4970. The influence of the oxidation was evaluated by comparison of the results from both atmospheres.

40287 (KFK—4100, pp 4200/79-4200/87) **Investigations of the mechanical behaviour of cladding material for APWR.** Petersen, C.; Schneider, H.; Schweiger, W. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Material- und Festkoerperforschung 2 - Teilinstitut Huell- und Strukturmaterialien). Sep 1987. (In German). NTIS (US Sales Only), PC A16/MF A01. Order Number DE88754024/JAW.

In Nuclear Safety Project. Annual report 1986.

A temperature dependence of stress exponent was found in both materials. The stress exponent of W.-Nr. 1.4914 decreases from values of 15 at 600/sup 0/C to those of 3 at the beginning of phase transformation range (785/sup 0/C), whereupon the α-γ-range a value of 6 was found. Above 900/sup 0/C a constant value of stress exponent of 4 appears, a value which was measured for pure material. The W.-Nr. 1.4970 shows at 600/sup 0/C very high stress exponent values of 70, which decreases with increasing temperature to a value of 4 at 900/sup 0/C and remains constant on this level up to 1050/sup 0/C.

40288 **(KFK—4273) Creep and creep-rupture behaviour of the SNR-300-permanent-structure-material X6CrNi 1811 (DIN 1.4948).** Schirra, M. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Material- und Festkoerperforschung; Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Projekt Schneller Brueter). Feb 1988. 156p. (In German). NTIS (US Sales Only), PC A08/MF A01. Order Number DE88754025/JAW.

Six SNR-specified melts of the austenitic structure-material of the German Fast Breeder Reactor SNR 300 were investigated on their creep-rupture-strength and creep-behaviour in a temperature range lasting from 500-800/sup 0/C; in particular the time range 10/sup 4/ hours to > 10/sup 5/ hours (=> 10 years) was experimentally covered by long-term tests. Out of two melts there where welded and unwelded specimens of two different types of weldings comparatively tested. Based on the continuously registrated creep-curves it is possible to give exact statements relating to technical relevant yield-limits and to the creep-behaviour. Variations of the T, t-relationship of the creep-rupture and creep results, as a result of structure changes, are pointed out and the consequences referring to extrapolation shall be discussed. Special test series enable to show out the influence of the specimen form, specimen direction and test atmosphere on the creep-rupture values. Also the influence of the solution temperature and annealing treatments. Additionally it is shown, that a previous cold-working (≅ 12%) positively influences the creep- and creep-rupture values in the same manner as previous deformation at test temperature. As a result of a comparison of the creep-rupture results of the SNR-specified melts with those of the commercial material it is obvious that there is a more narrow scatter band given by the SNR-melts.

40289 **(KFK—4372) Electrochemical corrosion investigations on austenitic CrNi-steels in nitric acid with and without additions of metal ions.** Simon, R. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Material- und Festkoerperforschung; Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Projekt Wiederaufarbeitung und Abfallbehandlung). Apr 1988. 137p. (In German). (PWA—7/88). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88754027/JAW.

The aim of the present work was to develop an electrochemical short-time test procedure for detecting intergranular corrosion (IGC) susceptibility of austenitic CrNi-steels in strongly oxidizing media, as e.g. concentrated nitric acid. This procedure should cover the test parameters of the usually applied ASTM Standard Huey Test, which is performed in boiling 14.4 n nitric acid. The described electrochemical test procedure - a potentiostatic polarisation of steel specimens in the transpassive range - is presented as an alternative to the Huey Test with equivalent results, but with a reduced testing time. (orig./IHOE).

40290 **(KFTI—87-19) Evolution of segregation of eta-phase in austenitic stainless steel at heavy ion irradiation.** Bryk, V.V.; Kiryukhin, N.M.; Matvienko, B.V.; Neklyudov, I.M.; Chernyj, B.P. (AN Ukrainskoj SSR, Kharkov. Fiziko-Tekhnicheskij Inst.). 1987. 11p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703437/JAW.

Evolution of recipitation of eta-phase (Ni/sub 3/Ti) in the austenitic stainless steel irradiated by Cr/sup 3+/(3 MeV) ions at 908 K in the dose rate internal 15...160 biased/ at has been studied by the electron microscopy method. It is established that plate precipitations of eta-phase, which average sizes increases with radiation time, and concentration decreases, are observed before 130 biased/at radiation dose. Evolution of lameblar precipitations depending on the radiation dose is satisfactorily described within the framework of the coalescence theory. At doses higher than 130 biased/at frequency range of precipitation mode occurs: eta-phase particles change from plane into globular. 8 refs.; 8 figs.

40291 **(LA-UR—88-1470) Mathematical theory and calculations of magnetic hysteresis curves.** Hodgdon, M.L. (Los Alamos National Lab., NM (USA)). 1988. Contract W-7405-ENG-36. 16p. (CONF-880703—1). NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88011055/JAW.

From Joint INTERMAG/magnetism and magnetic materials conference; Vancouver, Canada (11 Jul 1988).

The differential equation, $\partial H/\partial t = \alpha$chemical bond$\partial B/\partial$tchemical bond$[f(B) - H] + \partial B/\partial tg(B, \partial B/\partial t)$, in which the constant α and the material functions f and g are suitably restricted, forms a theory of rate-independent and rate-dependent hysteresis in ferrites, ferromagnetic materials, magnetic thin films, and permanent magnetic materials. The theory provides mathematical expressions for the initial magnetization curve, the anhysteretic curve, the major loop, the symmetric and asymmetric minor loops, and the energy loss associated with their traversal. Functional forms for f and g that can be scaled to measured values of the closure point, the remanence, the coercivity and, for rate-independent applications, the nonlinear changes in the loop area and energy loss that accompany increases in the rates $\partial B/\partial t$ and $\partial H/\partial t$, are discussed. By allowing the material parameters to depend on angle, the variations in loop shape and coercive point with angle observed in uniaxially anisotropic materials are described. Sample calculations are presented for representative materials. 4 refs., 5 figs.

40292 (N—88-21498, pp vp) **Viscoplasticity theory based on overstress applied to the modeling of a nickel base superalloy at 815 C.** Krempl, E.; Lu, H.; Yao, D. Apr 1988. NTIS, PC A21/MF A01. (NASA-CP—10010; E—3956; NAS—1.55:10010; CONF-8606138—).

From 3. symposium on nonlinear constitutive relations for high temperature applications; Cleveland, OH, USA (11 Jun 1986).

Short term strain rate change, creep and relaxation tests were performed in an MTS computer controlled servohydraulic testing machine. Aging and recovery were found to be insignificant for test times not exceeding 30 hrs. The material functions and constants of the theory were identified from results of strain rate change tests. Numerical integration of the theory for relaxation and creep tests showed good predictive capabilities of the viscoplasticity theory based on overstress.

40293 (N—88-21498, pp vp) **Constitutive model with damage for high temperature superalloys.** Sherwood, J.A.; Stouffer, D.C. Apr 1988. NTIS, PC A21/MF A01. (NASA-CP—10010; E—3956; NAS—1.55:10010; CONF-8606138—).

From 3. symposium on nonlinear constitutive relations for high temperature applications; Cleveland, OH, USA (11 Jun 1986).

A unified constitutive model is searched for that is applicable for high temperature superalloys used in modern gas turbines. Two unified inelastic state variable constitutive models were evaluated for use with the damage parameter proposed by Kachanov. The first is a model (Bodner, Partom) in which hardening is modeled through the use of a single state variable that is similar to drag stress. The other (Ramaswamy) employs both a drag stress and back stress. The extension was successful for predicting the tensile, creep, fatigue, torsional and nonproportional response of Rene' 80 at several temperatures. In both formulations, a cumulative damage parameter is introduced to model the changes in material properties due to the formation of microcracks and microvoids that ultimately produce a macroscopic crack. A back stress/drag stress/damage model was evaluated for Rene' 95 at 1200 F and is shown to predict the tensile, creep, and cyclic loading responses reasonably well.

40294 (N—88-21498, pp vp) **Unified creep-plasticity model suitable for thermo-mechanical loading.** Slavik, D.; Sehitoglu, H. Apr 1988. NTIS, PC A21/MF A01. (NASA-CP—10010; E—3956; NAS—1.55:10010; CONF-8606138—).

From 3. symposium on nonlinear constitutive relations for high temperature applications; Cleveland, OH, USA (11 Jun 1986).

An experimentally based unified creep-plasticity constitutive model was implemented for 1070 steel. Accurate rate and temperature effects were obtained for isothermal and thermo-mechanical loading by incorporating deformation mechanisms into the constitutive equations in a simple way.

40295 (N—88-21498, pp vp) **Constitutive response of Rene 80 under thermal mechanical loads.** Kim, K.S.; Cook, T.S.; Mcknight, R.L. Apr 1988. NTIS, PC A21/MF A01. (NASA-CP—10010; E—3956; NAS—1.55:10010; CONF-8606138—).

From 3. symposium on nonlinear constitutive relations for high temperature applications; Cleveland, OH, USA (11 Jun 1986).

The applicability of a classical constitutive model for stress-strain analysis of a nickel base superalloy, Rene' 80, in the gas turbine thermomechanical fatigue (TMF) environment is examined. A variety of tests were conducted to generate basic material data and to investigate the material response under cyclic thermomechanical loading. Isothermal stress-strain data were acquired at a variety of strain rates over the TMF temperature range. Creep curves were examined at 2 temperature ranges, 871 to 982 C and 760 to 871 C. The results provide optimism on the ability of the classical constitutive model for high temperature applications.

40296 **(NAGRA-NTB—86-25) Experiments on container materials for Swiss high-level waste disposal projects. Part 3.** Simpson, J.P.; Wallotton, P.H. (Sulzer Bros. Ltd., Winterthur (Switzerland)). (Nationale Genossenschaft fuer die Lagerung Radioaktiver Abfaelle (NAGRA), Baden (Switzerland)). Dec 1986. 44p. Nagra, CH-5401 Baden, Switzerland.

The present concept for final disposal of high-level waste in Switzerland consists of a repository at a depth of 1000 to 1500 m in the crystalline bedrock of northern Switzerland. The waste will be placed in a container which is required to function as a high integrity barrier for at least 1000 years. This report is the third in a series dealing with the evaluation of potential materials for such containers. Four materials were identified for further evaluation in the first of these reports; they were cast steel, nodular cast iron, copper and Ti-Code 12. It was concluded that further corrosion testing was needed to confirm these materials as candidate container materials. In the second of these reports it was shown that cast steel possessed sufficient corrosion resistance under repository conditions for it to be considered as the primary candidate material for a high-level waste container. The long term corrosion rate was estimated to be 20 μm/a. Immersion tests were carried out in both waters at 80 and 140 degrees C with two levels of oxygen, zero and 0.1 μg/g. The corrosion of cast steel as well as nodular cast iron under all conditions tested was uniform. It was observed that the corrosion rate was greater in the higher salinity water and at the higher oxygen level. The effect of temperature was not so marked. 6000 hour exposure corrosion rates observed were as high as 60 μm/a for cast steel in Boettstein water with 0.1 μg/g oxygen at 80 degrees C and 31 μm/a at 140 degrees C. The oxygen will be quickly consumed (e.g. by the corrosion reaction itself) and anaerobic conditions will predominate shortly after closure. The relevant long term data are therefore the zero oxygen results which range from 4 μm/a in Saeckingen water at 140 degrees C to 18 μm/a in Boettstein water at 140 degrees C. 20 refs., 11 figs., 14 tabs.

40297 (NIIAR—6(717)) Investigation of californium 249 thin films. Stupin, V.A.; Seleznev, A.G.; Radchenko, V.M.; Droznik, R.R. (Nauchno-Issledovatel'skij Inst. Atomnykh Reaktorov, Dimitrovgrad (USSR)). 1987. 14p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703452/JAW.

The method of X-ray diffractometry and measurement of electric resistance were used to investigate californium-249 films obtained by metal vapour condensation on alumina ceramics. Double hexagonal close-packed crystal structure of trivalent metallic californium is confirmed. Thin films of californium exhibit semiconducting properties (high electric resistivity, negative temperature coefficient of electric resistance in the 77-300 K range), that is associated with properties of film composition and environmental effect. 15 refs.; 3 figs.; 4 tabs.

40298 (ORNL—6467) Microstructural evaluation of UF_6 cylinder valve bodies. Vitek, J.M.; Heatherly, L.; Henson, T.J. (Oak Ridge National Lab., TN (USA)). May 1988. Contract AC05-84OR21400. 38p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88013336/JAW.

During the installation of copper-alloy valves used for storage cylinders of uranium hexafluoride, cracking has been observed recently. To determine the cause of these cracks, the microstructure of these valves was examined in detail by optical metallography, Auger spectroscopy, transmission electron microscopy, and electron microprobe analyses. It was found that the cracks were associated with intergranular oxides. These films consisted primarily of aluminum-rich oxides. Auger spectroscopy also indicated that some areas were essentially pure aluminum. It was concluded that insufficient homogenization of the melt led to the retention of aluminum-rich areas and that these areas promoted extensive oxidation and cracking during further processing. It was recommended that a copper-aluminum master alloy be used in the future for alloying rather than pure aluminum as is the present practice, and that sufficient homogenization and stirring be employed during melting. 5 refs., 10 figs., 4 tabs.

40299 (PB—88-196977/XAB) Development of 2 1/4Cr-1Mo steel with high strength and high resistance to hydrogen attack. Nagae, M.; Tsukamoto, H.; Tagawa, H.; Suzuki, H.; Hayashida, M. (Nippon Kokan K.K., Tokyo). 1987. 10p. NTIS, PC E04/MF A01.

Included in Nippon Kokan Technical Report No. 51: Overseas, 37-45(Dec 1987).

An investigation was carried out to develop the modified 2 1/4Cr-Mo steel suitable for the application to high-temperature and high-pressure hydrogen atmosphere such as coal-conversion plants. The influence of V and/or Nb addition on the mechanical properties at elevated temperature and the resistance to hydrogen attack of 2 1/4Cr-Mo steel was examined. It was shown that the addition of 0.3%V and small amount of Nb is effective to increase the creep-rupture strength at 900 F and to improve the resistance to hydrogen attack. These effects were due to the change in carbide morphology. Based on the experimental results, steel plates were manufactured at Keihin Works. This newly developed steel demonstrated higher strength at elevated temperature, and hence the higher design stress-intensity value at 900 F than that of conventional 2 1/4Cr-1Mo steel. This steel also showed a marked improvement in hydrogen-attack resistance superior to conventional 3Cr-1Mo steel, and good resistance to temper embrittlement, weld cold cracking and reheat cracking.

40300 (PNL-SA—15720) Computer simulation of high energy displacement cascades. Heinisch, H.L. (Pacific Northwest Lab., Richland, WA (USA)). Mar 1988. 31p. (CONF-880378—1).

From Workshop on the effects of recoil spectrum and nuclear transmutation on the evolution of the microstructure; Lugano, Switzerland (24 Mar 1988).

A methodology developed for modeling many aspects of high energy displacement cascades with molecular level computer simulations is reviewed. The initial damage state is modeled in the binary collision approximation (using the MARLOWE computer code), and the subsequent disposition of the defects within a cascade is modeled with a Monte Carlo annealing simulation (the ALSOME code). There are few adjustable parameters, and none are set to physically unreasonable values. The basic configurations of the simulated high energy cascades in copper, i.e., the number, size and shape of damage regions, compare well with observations, as do the measured numbers of residual defects and the fractions of freely migrating defects. The success of these simulations is somewhat remarkable, given the relatively simple models of defects and their interactions that are employed. The reason for this success is that the behavior of the defects is very strongly influenced by their initial spatial distribution, which the binary collision approximation adequately models. The MARLOWE/ALSOME system, with input from molecular dynamics and experiments, provides a framework for investigating the influence of high energy cascades on microstructure evolution. 36 refs., 8 figs., 1 tab.

40301 (RFP—3790) Calculation of oxygen diffusion in plutonium oxide films during the high-temperature oxidation of plutonium-1 weight percent gallium in 500 torr of air. Stakebake, J.L. (USDOE Albuquerque Operations Office, NM; Rockwell International Corp., Golden, CO (USA). Rocky Flats Plant). 27 May 1988. Contract AC04-76DP03533. 8p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88013618/JAW.

Oxygen self-diffusion in PuO/sub 1.995/ was calculated from rate constants obtained for the parabolic oxidation of the Pu-1 wt % Ga alloy in 500-torr dry air between 250 and 480{degree}C. The activation energy for oxygen vacancy diffusion in the n-type PuO/sub 2-x/ is 22.6 kcal/mole. Results from this investigation are compared with other reported results, and possible explanation for the difference in results is discussed. 21 refs., 5 figs., 1 tab.

40302 (RFP—4150) Cleaning metal substrates using liquid/supercritical fluid carbon dioxide. Motyl, K.M.; Thomas, R.L. (ed.); Morales, L.M. (Rockwell International Corp., Golden, CO (USA). Rocky Flats Plant). 25 Jan 1988. Contract AC04-76DP03533. 33p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88013617/JAW.

Liquid/supercritical fluid carbon dioxide (L/SCF-CO_2) can be employed as an alternative to halocarbon solvents that are conventionally used for washing organic and inorganic contaminants from the surface of metal parts and machining fines. The cleaning process was demonstrated at Rocky Flats Plant on the laboratory scale for steel and uranium substrates and was found compatible with plutonium metal. The efficacy of this new cleaning method depends on process pressure, temperature, and fluid flow rate as well as cleaning time. Within the parameter range studied, cleaning efficiency generally improved upon increasing process pressure and flow rate. To date, L/SCF-CO_2 cleaning has been used to effect very low residue cleaning of metal (steel, uranium) surfaces without halogen introduction. The process was also used successfully to remove more than 99.5% of the light hydraulic oil from steel fines. 29 refs., 25 figs., 1 tab.

40303 (RFP—4173) Casting of high-quality uranium-3/4 weight percent titanium alloy ingots for extrusion. Jackson, R.J.; Thomas, R.L. (ed.). (Rockwell International Corp., Golden, CO (USA). Rocky Flats Plant). 14 Mar 1988. Contract AC04-76DP03533. 24p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88013614/JAW.

The vacuum-induction melting, alloying, and casting of U–3/4 wt. % alloys ingots for extrusion is discussed. A procedure that allows casting of sound ingots of widely different geometries is presented. The cast ingots were free from cold shuts, surface and internal gas porosity, interdendritic porosity, and centerline defects. Even though all ingots were sound, three of the six ingot geometries exhibited titanium macrosegregation tendency. The macrosegregation of the three geometries was related to an improper solidification pattern and slow cooling rate. Three of the geometries had excellent titanium homogeneity, and these geometries are presently used to cast sound and homogeneous U–3/4 wt. % Ti ingots for extrusion into rod, bar, and tube. 5 refs., 15 figs., 3 tabs.

40304 **(SAND—86-2636) FY 1985 summary of WIPP [Waste Isolation Pilot Plant] waste package corrosion and metallurgy laboratory research.** Molecke, M.A. (ed.); Van Den Avyle, J.A. (ed.). (Sandia National Labs., Albuquerque, NM (USA)). May 1988. Contract AC04-76DP00789. 63p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE88012752/JAW.

This document serves as the technical summary report for all "waste package interactions technology" laboratory studies conducted during Fiscal Year 1985 on the topics of nuclear waste container corrosion and metallurgical evaluations. The research focuses predominantly on the ASTM alloy Grade-12 titanium. These studies are part of the Waste Isolation Pilot Plant (WIPP) - Waste Package Performance experimental program. The topics and results summarized include: optimization of Grade-12 titanium thermomechanical processing; effects of iron contamination on the corrosion of Grade-12 titanium; effects of exposure to gamma radiation and salt brine on titanium mechanical properties; evaluation of upset welding for Grade-12 canisters; and, determination of the effects of hydrogen on Grade-12 titanium hydrogen-induced crack growth resistance. As of this time, no significant problems in the behavior of Grade-12 Ti have been measured in the laboratory which would preclude its usage for nuclear waste containers in salt, or elsewhere. Unresolved concerns on crevice corrosion, pitting, hydrogen sorption effects, etc., are continuing to be quantified in the laboratory. 56 refs., 21 figs., 11 tabs.

40305 **(SAND—86-9009) Oxidation and chromium depletion of Alloy 800 and 316SS by molten $NaNO_3$-KNO_3 at temperatures above 600{degree}C.** Bradshaw, R.W. (Sandia National Labs., Livermore, CA (USA)). Jan 1987. Contract AC04-76DR00789. 39p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88010499/JAW.

The corrosion behavior of Alloy 800 and Type 316 stainless steel in molten $NaNO_3$-KNO_3 was studied at temperatures from 605{degree}C to 630{degree}C. Corrosion behavior was significantly different from that previously reported in nitrate melts at temperatures up to 600{degree}C and involved a combination of oxidation, internal nitridation and sodium metallate formation. Corrosion kinetics, determined metallographically, switched from a parabolic to a linear rate equation as temperature increased. Corrosion was uniform and resulted in metal losses on the order of 100 micronsyear at 630{degree}C. Among the alloying elements, chromium was depleted from the alloy as the result of a basic fluxing process. The kinetic equations describing chromium depletion also changed from parabolic to linear with increasing temperature. The effect of the equilibrium chemistry of the melt on the corrosion behavior of the alloys is analyzed and possible corrosion mechanisms are discussed. 24 refs., 8 figs., 2 tabs.

40306 **(SAND—87-2669C) Characterization of layers created using surface modification techniques.** Borders, J.A. (Sandia National Labs., Albuquerque, NM (USA)). 1988. Contract AC04-76DP00789. 11p. (CONF-8805134—4). NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88011918/JAW.

From Ion implantation and plasma assisted processes for industrial applications conference; Atlanta, GA, USA (21 May 1988).

Modern surface modification techniques, such as ion implantation, are capable of treating surface layers with properties very different from those of the bulk underlying material. By correlating measured chemical and structural changes, induced by a surface modification method, with the changes in the physical properties of interest, an understanding can be developed as to why a particular method of modification produces a surface layer with specific properties. There are a large number of modern analytical techniques capable of probing the chemical and structural properties of material surfaces. These methods are reviewed with emphasis on the techniques that are most commonly and commercially available. Examples of applications of these methods to surface-modified materials are given. 15 refs., 14 figs., 1 tab.

40307 **(SAND—88-0880) Static and dynamic metal-metal friction at plastic stress levels.** Bourcier, R.J.; Schmale, D.T. (Sandia National Labs., Albuquerque, NM (USA)). May 1988. Contract AC04-76DP00789. 19p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88011281/JAW.

A new test technique has been developed for adhesive metal/metal friction at high sliding rates and plastic stress levels. The test specimen consists of a thick walled metal tube and a tapered metal rod. The rod is pulled through the tube at rates up to {approximately}10^4mm/sec. The tubes plasticity can be varied by changing the tapered rod. Finite element simulations were used. Both the quasistatic code JAC and the dynamic wave propagation code PRONTO were used. Tests were performed using annealed OFHC copper tubes and cold worked 316 stainless steel rods. Two tests were performed at 1.67 mm/sec: one unlubricated, and one using MoS_2 lubrication resulted in approximately a factor of two reduction of load. The third test was unlubricated at 7.44 {times} 10^3mm/sec. This test yielded a maximum load one half that found in the unlubricated static test, indicating a rate dependence of the plastic friction coefficent. The finite element model was compared with experiment. Results suggest that the unlubricated, static test yields a value $\mu = 0.4$ while both the lubricated, static test, and the unlubricated, dynamic test result in $\mu = 0.2$. This is consistent with those of previous workers and with features observed on the wear surfaces using scanning electron microscopy.

40308 **(SERI/STR—211-3352) Structure of amorphous silicon alloy films: Annual subcontract report, 15 January 1987--14 January 1988.** Norberg, R.E.; Fedders, P.A. (Washington Univ., St. Louis, MO (USA). Dept. of Physics). May 1988. Contract AC02-83CH10093. 35p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88001167/JAW.

The principal objective of the first year of this research program was to improve our understanding at the microscopic level of amorphous silicon--germanium alloy films deposited under various conditions to assist researchers in producing higher quality films. The method was a joint theoretical and experimental approach to the correlation of nuclear magnetic resonance (NMR), electron spin resonance (ESR), other characterizations, especially relating to rearrangements of hydrogen. Deuteron magnetic resonance reveals the presence of (and changes in) tightly bonded hydrogen (deuterium), weakly bonded hydrogen, molecular hydrogen, and rotating silyl groups. Ge-D configurations appear to be more varied than Si-D. It has been shown that ESR hyperfine structure results can be interpreted very well via dangling bonds, but not with floating bonds. The presence of fluorine correlates with the occurrence of larger microvoid dimensions. 21 refs., 9 figs., 4 tabs.

40309 **(UCID—20726) The effects of furnace environment on the mechanical properties of vanadium.** dePruneda, J.H.; Gallegos, G.F.; Stratman, M.P. (Lawrence Livermore National Lab., CA (USA)). 22 Mar 1988. Contract W-7405-ENG-48. 15p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88012445/JAW.

We have conducted tests to ascertain whether or not exposure to erbia would adversely affect the mechanical properties of vanadium more than the regular annealing furnace environment. Mechanical properties of the vanadium exposed to erbia are not different from those of the vanadium to a regular annealing furnace environment. However, there is a change in the impurity levels, the carbon content increasing and the oxygen content decreasing. There is also anomalous behavior in the strain-hardening and elongation to failure of both the annealed and the erbia specimens. It is possible that hydrogen could have been released as a result of water reacting with the vanadium to form oxides. Very small amounts of hydrogen can impair the mechanical properties of vanadium. It is possible, on the basis of diffusion data, that, should hydrogen be generated in this fashion, it could diffuse completely through the vanadium and contaminate whatever is in contact with the vanadium. Further experiments should be conducted to verify whether or not hydrogen is in fact responsible for the anomalous strain-hardening and elongation-to-failure behavior. 20 refs., 8 figs., 3 tabs.

40310 **(UCRL—98231) Premartensitic microstructures as seen in the high-resolution electron microscope: A study of a Ni-Al alloy.** Schryvers, D.; Tanner, L.; Van Tendeloo, G. (Lawrence Livermore National Lab., CA (USA); Lawrence Berkeley Lab., CA (USA); Universitaire Instelling Antwerpen (Belgium)). 12 Feb 1988. Contract W-7405-ENG-48. 5p. (CONF-8706103—9). NTIS, PC A02/MF A01;1. Order Number DE88008042/JAW.

From NATO advanced study institute on alloy phase stability; Crete, Greece (14 Jun 1987).

The present study indicates that the B2 β-phase in quenched Ni/sub 62.5/Al/sub 37.5/ is distorted by displacement waves involving a planar shuffling of atoms resembling the final 7R martensite structure and with wavelenghts of the order of 1.3 nm. The appearance of a <110><110> type modulation with the indicated periodicity corresponds well with recent inelastic neutron scattering results which reveal nonlinear behavior in the TA<110> phonon dispersion curve around the same wavelengths indicating a partial lattice softening for such waves. In bulk material all six equivalent wave-vectors are equally present. These distortional modulations are configured in some form of three-dimensional assembly. Following the interpretation given above, it can be concluded that a one-dimensional domain structure along one of six <110> directions may exist. However, the beating of six displacement waves with apparently uncorrelated phase and wavelengths rules out the existence of a "conventional" three-dimensional domain structure. For this reason it is uncertain whether much more information can be gained from such image simulations. There are now numerous indications that the underlying structure to the tweed contrast in this alloy is a precursor effect of the martensitic transformation. However, a detailed description of the effective correlation between the distorted parent phase and the martensitic product phase has yet to be developed. Recent HREM results reveal the existence of a sequence of different structures in the transition region between the modulated β-phase and the martensitic phase, depending on parameters such as the local composition and stress. Such transition structures include modulated β-phase in which only one [110] modulation is preferred or in which the periodicity differs from the above described 1.3 nm and the FCT L1/sub o/ martensite with single shear defects. 26 refs., 1 fig.

40311 **(WHC-SA—0210) Principles and applications of electro-spark deposition.** Johnson, R.N. (Westinghouse Hanford Co., Richland, WA (USA)). Dec 1987. Contract AC06-87RL10930. 26p. (CONF-880187—1). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88011943/JAW.

From 1. international conference on surface modification technologies; Phoenix, AZ, USA (27 Jan 1988).

Electro-spark deposition (ESD) is a pulsed-arc micro-welding process using short-duration, high-current electrical pulsed to deposit an electrode material on a metallic substrate. It is one of the few methods available by which a fused, metallurgically bonded coating can be applied with such a low total heat input that the bulk substrate material remains at or near ambient temperatures. The short duration of the electrical pulse allows an extremely rapid solidification of the deposited material and results in an exceptionally fine-grained, homogeneous coating that approaches an amorphous structure. This structure is believed to contribute to the good tribological and corrosion performance observed for hardsurfacing materials used in demanding environments. A brief historical review of the process is provided, followed by descriptions of the present state-of-the-art, of the performance and applications of electro-spark deposition coatings in nuclear and fossil energy environments, and of potential applications in development. 23 refs., 23 figs., 3 tabs.

40312 **Microstructure and mechanical properties of a 3Cr-1.5Mo steel.** Klueh, R.L.; Nasreldin, A.M. (Oak Ridge National Lab., Oak Ridge, TN (US)). *Metallurgical Transactions, [Section] A: Physical Metallurgy and Materials Science;* **18A**: No. 7, 1279-1290(Jul 1988).

Tensile and impact properties were determined for a steel (3 wt pct Cr-1.5 wt pct Mo-0.1 wt pct V-0.1 wt pct C) considered a candidate for elevated-temperature pressure-vessel applications. The steel was tested in two heat-treated conditions: normalized and tempered and quenched and tempered for various tempering conditions. Similar tempering treatment for the quenched and the normalized steels led to similar strengths. However, for the lowest tempering parameter used, the impact properties for the quenched-and-tempered steel exceeded those for the normalized-and-tempered steel, resulting in an excellent ductile-brittle transition temperature (-70°C) and upper-shelf energy (225 J) for the quenched-and-tempered steel at a high strength (770 MPa ultimate tensile strength). Further tempering reduced the strength for the steel in both heat-treated conditions. The impact properties of the quenched steel were only slightly changed by further tempering, but those for the normalized steel improved, eventually equaling those for the quenched-and-tempered steel. The difference in impact properties after the two heat treatment was attributed to a difference in bainite microstructures.

40313 **(DP-tr—108) Studies of the transpassive nitric acid corrosion of various austenitic CrNi steels in the prolonged Huey test (65% HNO_3, 120{degree}C, 720 h).** Kraft, R.; Leistikow, S.; Pott, E. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Projekt Wiederaufarbeitung und Abfallbehandlung). 13 May 1988. Contract AC09-76SR00001. Translation of KFK-3802, November 1984. 100p. NTIS, PC A06/MF A01;1.

Aim of these experiments was to test the quality and the ability to longtime service conditions of various austenitic stainless steels of type 18 10 CrNi and 25 20 CrNi by ASTM Standard Huey-Test, prolongated up to 15 periods of 48 h each. By gravimetry the rate of metal loss, by metallography the maximum depth of local dissolution, by microscopy the overall appearance of the corroded surface was checked and evaluated. Results show differences in metal dissolution rate as function of basic alloy composition (in Fe,Cr,Ni), content of minor elements (in C,Si,Mo,S), and bulk structure (grain size, distribution of inclusions, precipitation of carbides etc.) as resulting of industrial production and laboratory heat treatments. The best corrosion behavior was shown by the low carbon 25 20 CrNi stainless steels in the fine-grain, highly pure, solution annealed condition, not showing any trend to accelerate corrosion when sensitizing heat treatment or long-time exposure were applied. The prolonged Huey-Test proved to be a sensitive method to evaluate the corrosion behavior of steels for engineering purposes, especially the effects caused by the main alloy components, small impurity concentrations, and differences in homogenity of the bulk structure. Thus, in combination with the evaluation of local intercrystalline dissolution (penetration) in the metallographic cross-section, difference in quality can be determined and long-term loss of wall thickness roughly estimated.

40314 **Electrical resistivity of small dislocation loops in irradiated copper.** Zinkle, S.J. (Oak Ridge National Lab., TN (USA)). *Journal of Physics F (London). Metal Physics (London);* **18**: No. 3, 377-391(Mar 1988). Contract AC05-84OR21400.

Small loops and stacking fault tetrahedra of sizes 1 to 10 nm were created during irradiation of copper with 14 MeV neutrons at room temperature. The electrical resistivity of these defect clusters has been investigated using a combination of resistivity and electron microscopy techniques. The dislocation specific resistivity of the loops was determined to be rhosub(d) $\simeq 1.4 \times 10^{-25}\ \Omega\ m^3$ at a temperature of 4.2 K, in fair agreement with the literature value for straight dislocations in copper. The effective Frenkel pair resistivity of the point defects in the loops was constant over the fluence range 1×10^{20} to 2×10^{24} n m-?², with a value of about 1.7 $\mu\Omega$m per unit concentration of Frenkel pairs. This is only slightly less than the specific resistivity of isolated Frenkel pairs in copper, and suggests that clustering of point defects does not necessarily lead to a large decrease in the Frenkel pair resistivity. The ratio of surviving to created point defects (eta) decreased from 11 to 4.7% as the neutron fluence increased from 1×10^{20} to 3×10^{21} n m^{-2}.

40315 **Effects of microstructure on the erosion of Al-Si alloys by solid particles.** Shin, Y.W.; Sargent, G.A.; Conrad, H. (Korea Advanced Energy Research Institute, Taejun, Chungnam (KR)). *Metallurgical Transactions, [Section] A: Physical Metallurgy and Materials Science;* **18A**: No. 3, 437-450(Mar 1988).

The effects of microstructure on the erosion of Al-Si alloys by 40 μm Al/sub 2/O/sub 3/ particles were investigated. The impact angle dependence of the erosion rate of Al and the Al-Si alloys exhibited the ductile signature, whereas that for pure Si showed the brittle signature. The eroded surface of pure Al was characterized by craters, lips, overlaps and folds, and platelets; that for pure Si exhibited complex radial and lateral cracking at the impact site. At shallow impact angles these features were elongated in the direction of the tangential component of the velocity in both materials. The measured erosion rates of the Al-Si alloys were found to be in accord with an inverse rule of mixtures based on pure Al and pure Si; better agreement was, however, obtained if pure Al and the eutectic were taken as the two constituents for the hypoeutectic alloys, and pure Si and the eutectic for the hypereutectic alloys. The microstructure size had two effects: (a) scaling with respect to the impact damage zone size and (b) an influence on the physical and mechanical properties which govern material removal. The present results are considered in terms of current models for the erosion of ductile and brittle materials.

40316 **Shock-compression ultrapressure research.** Nellis, W.J. (Lawrence Livermore National Lab., Univ. of California, Livermore, CA (US)). *Scripta Metallurgica;* **22**: No. 2, 121-126(Feb 1988). Contract W-7405-ENG-48.

Shock compression is used to achieve dynamic ultrapressures over an extremely wide range. One of the principal advantages of the dynamic method is that the high pressures, densities, and internal energies achieved are determined simply by the conservation of mass, momentum, and energy. Diagnostic techniques have been developed to measure the properties of materials at high dynamic pressure during the experimental lifetime, which is generally less than 1 μs. Shock compression is an irreversible process accompanied by heating, which must be taken into account in the analysis of experimental data and in relating shock-compression data to states achieved by static compression methods. The purpose of this paper is to describe briefly the phenomenology of shock compression, to discuss how shock data for metals have been used to generate the pressure scales for all static-compression experiments above — 5 GPa, and to describe ways in which shock compression might potentially be used to synthesize andor process into useful form novel materials like the new high-T/sub c/ superconducting oxides.

40317 **New technique for measurement of electrode strain during electrochemical reactions.** Butler, M.A.; Ginley, D.S. (Sandia National Labs., Albuquerque, NM (US)). *Journal of the Electrochemical Society;* **135**: No. 1, 45-50(Jan 1988).

A new technique, based on an optical fiber interferometer, is described for in situ measurement of electrode strain during electrode reactions. A model is presented which relates changes in optical path length of the fibers in the various strain components in the electrode. Measurements of strain associated with electrodeposition of nickel as a function of the thickness of the nickel layer are reported and compared to a simple model. Measurements of strain associated with the anodic oxidation of titanium are also reported. The strain generated in the titanium has a component which is independent of applied potential after oxide growth is complete and a component which is dependent on the applied potential. The potential dependent term is identified as an electrostriction effect in the anodic oxide enhanced by the porous nature of the electrode. The potential independent term comes from compressive stress in the anodic oxide induced by the growth process.

40318 **(Y/TR—88/1) Deformation and fracture of W--Ni--Fe heavy alloys.** Churn, Kil-Sung. (Korea Advanced Inst. of Science, Seoul (Republic of Korea). Dept. of Materials Science). 1988. Contract AC05-84OS21400. Translation source information not available. 115p. NTIS, PC A06.

Investigations were carried out not only into the effects of composition but also into the effects of particle size, sintering temperature, and sintering time on the plastic deformation and fracture of W--Ni--Fe heavy alloys. The change in the microstructure of heavy alloys with different sintering conditions was also examined. The plastic deformation and fracture behaviors of alloys of different compositions were also studied and compared with the results of the microstructure study. The ratio of Ni/Fe was set at a constant value 1/1, which was known to be the best optimum value [6,7,8,9]. The concentration of tungsten was varied from 90 to 98 w/o as in commercial materials. 89 ref., 33 figs., 10 tabs.

40319 **Preparation and fabrication of rare earth magnetic materials.** Beaudry, B.J. (Iowa State Univ., Ames (USA)). pp 785-790 of Advances in cryogenic engineering. Volume 33. Fast, R.W. (ed.). New York, NY; Plenum Press (1988). (CONF-8706125—). Contract W-7405-ENG-82.

From Cryogenic engineering conference; St. Charles, IL, USA (14 Jun 1987).

Laboratory methods to produce and study binary alloys between rare earths and transition elements for magnetic refrigeration purposes are presented. Tradeoffs between magnetic properties and purity are assessed. Large scale methods to produce permanent magnet materials and the application of these methods to magnetic refrigeration alloys are also evaluated. Alloys used as illustrations include CeIr, SmCo, PrNi, and NdFeB systems.

40320 **Measured properties of GdNi for magnetic refrigeration applications.** Zimm, C.B.; Stewart, W.F.; Barclay, J.A.; Campenni, C.K.; Overton, W.; Olsen, C.; Harding, D.; Chesebrough, R.; Johanson, W. (Astronautics Technology Center, Madison, WI (USA)). pp 791-798 of Advances in cryogenic engineering. Volume 33. Fast, R.W. (ed.). New York, NY; Plenum Press (1988). (CONF-8706125—).

From Cryogenic engineering conference; St. Charles, IL, USA (14 Jun 1987).

The refrigerant relevant properties of GdNi were measured. They include heat capacity, adiabatic temperature change induced by a magnetic field, magnetization for 0 to 9 T fields, zero field magnetic susceptibility, electric resistivity, and thermal conductivity. The resistivity measurements on as-cooled polycrystal samples show crack formation from thermal cycling. This effect is reduced in hot-pressed samples. Several thermomagnetic properties were remeasured on hot-pressed samples and showed little or no change compared to data on bulk crystals. Experimental data are compared to results of mean field theory calculations.

40321 **Microstructures and mechanical properties of Ni/sub 3/Al alloyed with iron additions.** Horton, J.A.; Liu, C.T.; Santella, M.L. (Oak Ridge National Lab., Oak Ridge, TN (US)). *Metallurgical Transactions,* [*Section*] *A: Physical Metallurgy and Materials Science;* **18A**: No. 7, 1265-1278(Jul 1987).

The alloying behavior of iron in B-doped Ni/sub 3/Al was studied using optical and transmission electron microscopy for microstructural analysis and tensile testing for mechanical property evaluation. The aluminide dissolves less than 15 at. pct iron. At iron levels of 15 pct, depending on the aluminum level, formation of both transformed B2 phase (B′) and disordered fcc phase (γ) is observed. The phase relationships in the aluminide containing 10 pct iron were studied in detail by quenching from temperatures below 1370°C. Tensile properties of nickel-iron aluminides were determined as functions of iron content and test temperature. The tensile results are discussed in terms of solid-solution hardening, atomic size misfit, and precipitation of γ, B′, and carbides.

40322 **The influence of inclusion spacing and microstructure on the fracture toughness of the secondary hardening steel AF1410.** Garrison, W.M. Jr.; Moody, N.R. (Dept. of Metallurgical Engineering and Materials Science, Carnegie Mellon Univ., Pittsburgh, PA (US)). *Metallurgical Transactions,* [*Section*] *A: Physical Metallurgy and Materials Science;* **18A**: No. 7, 1257-1264(Jul 1987).

An approach to the ductile fracture of ultra high strength steels has been evaluated. According to this approach the critical crack tip opening, δ/sub IC/, will scale with X/sub 0/(R/sub V//R/sub I/vertical bar/sub R//sub 0/. X/sub 0/ is an average inclusion spacing and (R/sub V/R/sub I/)vertical bar/sub R//sub 0/ is the void radius divided by the radius of the inclusion nucleating the void evaluated at the average inclusion size. AF1410 was selected to test this approach because it has exceptionally high fracture toughness on aging at 510°C and because its toughness varies markedly with aging temperature. The results from this and earlier work showed a linear relationship exists between δ/sub IC/ and X/sub 0/(R/sub V//R/sub I/)vertical bar /sub R//sub 0/ for values of δ/

sub IC/ ranging from about 8 μm to 60 μm. The values of (R/sub V//R/sub I/)vertical bar /sub R//sub 0/ for AF1410 aged at 425°C and 510°C differed by a factor of two. Because the yield strengths and work hardening exponents were similar for the two aging temperatures, the difference in (R/sub V/R/sub I/)vertical bar /sub R//sub 0/ was attributed to changes in microstructure. The microstructures at the two aging temperatures differed in type and size of intra-lath carbides. Both the microstructure and inclusion spacing were found to influence the fracture toughness of AF1410. The average inclusion spacing for this heat of AF1410 was the largest of the six steels evaluated with this model. The model suggests that the large inclusion spacing is critical to the high toughness of AF1410 on aging at 510°C. This large inclusion spacing results not from an unusually low inclusion volume fraction but from a large average inclusion size.

40323 **The aging behavior of homogenized type 308 and 308CRE stainless steel.** Vitek, J.M.; David, S.A. (Metals and Ceramics Div., Oak Ridge National Lab., Oak Ridge, TN (US)). *Metallurgical Transactions,* [*Section*] *A: Physical Metallurgy and Materials Science;* **18A**: No. 7, 1195-1202(Jul 1987).

The aging behavior of type 308 stainless steel and type 308 stainless steel with controlled residual elements (308CRE) was studied. The alloys were initially homogenized, resulting in a fully austenitic structure in the type 308 alloy and a duplex austenite plus ferrite structure in the type 308CRE alloy. The materials were subsequently aged at 550, 650, 750, an 850°C for times up to 10,000 hours. Aging of the type 308 steel resulted in precipitation of chromium-rich M/sub 23/C/sub 6/, primarily along grain boundaries, followed by sigma-phase formation after long aging times (≧5000 hours). The aging response of the duplex type 308CRE steel was somewhat more complicated. Although the titanium-rich carbides, nitrides, and sulfides produced during homogenization remained stable during subsequent aging, some additional precipitation was found. G-phase formed within the residual ferrite but eventually redissolved. The ferrite partially dissolved during early aging and later transformed to sigma phase. The sigma-phase formed significantly faster in the aged type 308CRE alloy. The results are summarized in the form of TTT diagrams. A comparison is made with a similar aging study on the same alloys but starting with the as-welded condition.

40324 **The effect of phase continuity on the fatigue and crack closure behavior of a dual-phase steel.** Ramage, R.M.; Jata, K.V.; Shiflet, G.J.; Starke, E.A. Jr. (Dept. of Materials Science, Univ. of Virginia, Thornton Hall, Charlottesville, VA (US)). *Metallurgical Transactions,* [*Section*] *A: Physical Metallurgy and Materials Science;* **18A**: No. 7, 1291-1298(Jul 1987).

The effect of phase continuity on the low cycle fatigue and fatigue crack growth behavior of a Fe-C-Mn dual-phase steel has been investigated. Two microstructures, one consisting of continuous ferrite and the other continuous martensite, were examined. Although there was no difference in the low cycle fatigue lives between the two microstructures, the continuous martensite structure exhibited an extremely high fatigue threshold value of 20 MPa m/sup 1/2/, compared to 16 MPa m/sup 1/2/ for the continuous ferrite microstructure. A major effect of phase continuity has also been found in the crack closure levels during fatigue crack propagation studied over three decades of crack growth rates. The continuous martensite microstructure exhibited much higher closure levels due to the martensite constraining the plastic deformation in the ferrite and bearing a larger portion of the applied cyclic load. This effect is similar to the extrinsic toughening phenomenon cited in the literature. After accounting for the closure levels the intrinsic or effective fatigue crack growth rates are similar for the two microstructures. These intrinsic thresholds are predicted by employing experimentally obtained low cycle fatigue parameters and the ferrite grain size.

40325 **The representation of orientation distributions.** Wenk, H.R.; Kocks, U.F. (Dept. of Geology and Geophysics at the Univ. of California in Berkeley (US)). *Metallurgical Transactions,* [*Section*] *A: Physical Metallurgy and Materials Science;* **18A**: No. 6, 1083-1092(Jun 1987).

Textures are properly described as densities in a three-dimensional orientation space. The appropriate coordinates of this space are the Euler angles describing relative rotations or, equivalently, the location and azimuth of a vector on a sphere (a boat on the earth). The space spanned up by these angular coordinates has conventionally been chosen Cartesian, and the orientation distribution function (ODF) is then represented in two-dimensional (square) sections through this space, with contour lines. It is proposed that an alternative representation be used that maintains a closer connection to pole figures and inverse pole figures, which are projections of orientation space. There are advantages if ODF sections are also plotted in polar coordinates. The equivalents to pole figures are 'partial pole figures' or COD's (crystal orientation distributions); the equivalents to inverse pole figures are partial inverse pole figures or SOD's (sample orientation distributions). These representations are less distorted than conventional ODF's and display the symmetry properties in a more obvious way. In addition, both projections and sections should be plotted in equal-area projection; then, equal volume elements in orientation space are displayed by equal area elements in the representations. Common operations with these diagrams are outlined and illustrated using a rolled copper sample.

40326 **The relationship between toughness and microstructure in Fe-high Mn binary alloys.** Tomota, Y.; Strum, M.; Morris, J.W. Jr. (Ibaraki Univ., Faculty of Engineering, Hitachi-Shi (JP)). *Metallurgical Transactions,* [*Section*] *A: Physical Metallurgy and Materials Science;* **18A**: No. 6, 1073-1082(Jun 1987).

The influence of Mn content on the ductile-brittle transition in 16 to 36 wt pct Mn steels was investigated and interpreted in light of the evolving microstructure. It was found that when hcp ϵ martensite is present in the as-quenched condition or forms during deformation, it lowers the toughness. In 25Mn steels, the stress concentration at ϵ plate intersections result in the formation of planar void sheets along the {111}/sub γ/ planes. The deformation-induced α′ martensite in 16 to 20 pct Mn alloys enhances the toughness, but leads to a ductile-to-brittle transition at low temperatures that is due to the intrusion of an intergranular fracture mode. Binary alloys with greater than 31 pct Mn also fracture in an intergranular mode at 77 K although the impact energy remains quite high. Auger spectroscopy of the fracture surfaces shows no evidence of significant impurity segregation, which suggests the importance of slip heterogeneity in controlling intergranular fracture in these alloys.

40327 **Ignition of nickel in environments containing oxygen and chlorine.** Lee, Y.Y.; McNallan, M.J. (Dept. of Civil Engineering, Mechanics, and Metallurgy, Univ. of Illinois at Chicago, P.O. Box 4348, Chicago, IL (US)). *Metallurgical Transactions,* [*Section*] *A: Physical Metallurgy and Materials Science;* **18A**: No. 6, 1099-1108(Jun 1987).

The mixed oxidation of nickel in gases containing both oxygen and chlorine has been investigated using the techniques of thermogravimetric analysis and examination of the corrosion products by scanning electron microscopy. Two regimes of corrosion behavior have been detected: one in which a protective oxide film is present and the rate of corrosion is controlled by the transport of the volatile products of the reaction between the gas phase and the oxide, and one in which the protective film is penetrated and corrosion occurs rapidly enough to result in the ignition of the specimen. The oxide corrosion products on the specimens after corrosion have characteristic morphologies, with the products of volatilization type corrosion consisting of large grains and the products of ignition type attack consisting of fine spherical particles. Ignition is a serious hazard in environments containing 0.25 pct or more Cl/sub 2/ and 4 pct or more O/sub 2/ by volume at temperatures between 1000 K and 1100 K, but is not produced by exposures at higher temperatures. A model based on the stability of the protective film in steady state corrosion is presented which can be used to predict the transition from volatilization to ignition type attack.

40328 **On the inapplicability of Gibbs phase rule to coherent solids.** Johnson, W.C. (Dept. of Metallurgical Engineering and Materials Science, Carnegie Mellon Univ., Pittsburgh, PA (US)). *Metallurgical Transactions,* [*Section*] *A: Physical Metallurgy and Materials Science;* **18A**: No. 6, 1093-1098(Jun 1987).

A relationship is derived between the number of degrees of freedom, independent chemical components, and number of phases for a specially constructed nonhydrostatically stressed coherent solid in complete thermodynamic equilibrium. The results obtained are based on the thermodynamics of crystalline solids, and indicate that the degrees of freedom are independent of the number of phases present. This model is used to demonstrate that coherent solids do not obey Gibbs phase rule. It is also shown that domains of what are the same phase in the absence of all stress effects may occupy different states of deformation and hence possess different equilibrium compositions when the system is constrained to behave coherently. The results derived here are in complete agreement with recent work on coherent phase diagrams.

40329 **Stochastic modeling of the independent roles of particle size and grain size in transgranular cleavage fracture.** Lin, T.; Evans, A.G.; Ritchie, R.O. (Dept. of Materials Science and Mineral Engineering, Univ. of California, Berkeley, CA (US)). *Metallurgical Transactions, [Section] A: Physical Metallurgy and Materials Science;* **18A**: No. 4, 641-652(Apr 1987).

The independent roles of grain size and particle size on sharp crack and rounded notch toughness are investigated over a range of temperatures from the lower shelf into the early ductile/brittle transition region. The results are interpreted in terms of a weakest link statistical model wherein the onset of failure coincides with the critical propagation of a particle microcrack into the matrix. It is shown that, for a fixed particle size distribution, both sharp-crack and rounded-notch toughness decrease with increasing grain size. However, at fixed grain size, the sharp-crack toughness increases, while the rounded-notch toughness decreases with increasing particle size. Such effects result primarily from the difference in the number of activated particles in the plastic zone.

40330 **On the influence of strain-path changes on fracture.** Kestner, S.C.; Koss, D.A. (Dept. of Materials Science and Engineering, The Pennsylvania State Univ., University Park, PA (US)). *Metallurgical Transactions, [Section] A: Physical Metallurgy and Materials Science;* **18A**: No. 4, 637-640(Apr 1987).

Abrupt changes in strain path between uniaxial and equibiaxial tension are shown to have a large effect on plane-strain ductility. Data for titanium sheets, both with and without hydrides, show that a significant ductility enhancement occurs at a final strain state of plane-strain tension following multi-stage deformation sequences comprised of uniaxial and equibiaxial tensions. While the dependence of ductile fracture on both accumulated damage and strain hardening suggest that failure strains should be sensitive to a non-proportional strain-path history, the detailed cause(s) of the present effect is not known.

40331 **Growth of single crystal Terfenol-D crystals.** Verhoeven, J.D.; Gibson, E.D.; McMasters, O.D.; Baker, H.H. (Dept. of Materials Science and Engineering, Iowa State Univ., Ames, IA (US)). *Metallurgical Transactions, [Section] A: Physical Metallurgy and Materials Science;* **18A**: No. 2, 223-232(Feb 1987).

Rods of the highly magnetostrictive material, Terfenol-D, Tb/sub 0.3/Dy/sub 0.7/Fe/sub 2/, have been prepared by both Bridgman and float zone techniques. It is found that the dendritic growth front consists of parallel sheets of dendrites growing with a primary direction <112> and sheet planes of {111}. Unseeded rods show a strong preference for <112> alignment of the grains. Seeding experiments have been successful for <112> orientations but not <111>, and the cause of this difference is discussed. The <112> single crystal rods are seen to contain parallel {111} twin boundaries throughout their volume, growing near the central plane of the dendrite sheets. These results are analogous to those of Ge and Si. The role of the twin planes on domain wall motion and methods of eliminating the twins are discussed.

40332 **Hydrogen and deuterium diffusion in vanadium-titanium alloys.** Peterson, D.T.; Herro, H.M. (Dept. of Materials Science and Engineering and Senior Metallurgist, Ames Lab. - United States Dept. of Energy, Iowa State Univ., Ames, IA (US)). *Metallurgical Transactions, [Section] A: Physical Metallurgy and Materials Science;* **18A**: No. 2, 249-254(Feb 1987).

Hydrogen and deuterium diffusion coefficients were measured in vanadium-titanium alloys, containing up to 30 at. pct Ti, by Boltzmann-Matano techniques. Hydrogen and deutrium diffusivity decreased rapidly with titanium concentration. The diffusion coefficients showed an Arrhenius temperature dependence in each alloy between 230 and 473 K with activation energies that increased with titanium concentration. The diffusion coefficient decreased linearly with hydrogen concentration in all alloys. The terminal solid solubilities increased markedly with titanium concentration with deuterium showing a larger terminal solid solubility than hydrogen below ten percent titanium. The diffusion results do not fit a localized deep trapping of hydrogen by the titanium atoms.

40333 **Gamma to alpha phase transformation in cerium.** Zukas, E.G.; Pereyra, R.A.; Willis, J.O. (Los Alamos National Lab., P.O. Box 1663, Los Alamos, NM (US)). *Metallurgical Transactions, [Section] A: Physical Metallurgy and Materials Science;* **18A**: No. 1, 35-42(Jan 1987).

At 295 K the fcc γ phase of cerium transforms at about 8 kbars pressure to the fcc α phase, the transformation volume decrease being about 18 pct. During decompression, the transformation reverses with a hysteresis of about 2 kbars. The microstructural integrity suggests a mediating phase, but none was found. Complete transformation to alpha and its reversal deformed the internal grain microstructure and increased the lattice misorientation of the individual γ grains. Deformation bands were present along (11) planes. A similar transformation occurred during cooling of a pressurized specimen.

40334 **Effect of irradiation on failure mode during creep.** Gilbert, E.R.; Chin, B.A.; Duncan, D.R. (Pacific Northwest Lab., P.O. Box 999, Richland, WA (US)). *Metallurgical Transactions, [Section] A: Physical Metallurgy and Materials Science;* **18A**: No. 1, 79-84(Jan 1987).

In-reactor stress to rupture results in excess of 11,000 hours have been reported. Stress rupture properties during in-reactor testing of AISI 316 are greater than or equal to unirradiated material properties. Failure strains of pressurized tube specimens were stress-dependent with a minimum in failure strain occurring at 200 MPa for unirradiated tests. Higher failure strains at lower stresses resulted from a transition in crack propagation from triple point wedge cracking to grain boundary cavitation. The triple point cracking to cavitation transition was shifted to lower stresses by irradiation.

40335 **High-temperature ordered intermetallic alloys II; Proceedings of the Second Symposium, Boston, MA, Dec. 2-4, 1986.** Stoloff, N.S.; Koch, C.C.; Liu, C.T.; Izumi, O. University Park, PA; Materials Research Society (1987). 534p. (CONF-8612147—).

From 2. symposium on high-temperature ordered intermetallic alloys; Boston, MA, USA (2 Dec 1986).

The papers presented in this volume provide on overview of recent theoretical and experimental research in the field of high-temperature ordered intermetallic alloys. The papers are gouped under the following headings: ordering behavior and theory, microstructures, mechanical behavior, alloy design and microstructural control, and metallurgical properties. Specific topics discussed include antiphase domains, disordered films and the ductility of ordered alloys based on Ni_3Al; kinetics and mechanics of formation of Al-Ni intermetallics; deformability improvements of L1(2)-type intermetallic compounds; B2 aluminides for high-temperature applications; and rapidly solidified binary TiAl alloys.

40336 **Two-phase nickel aluminides.** Khadkikar, P.S.; Vedula, K.; Shabel, B.S. pp 157-164 of High-temperature ordered intermetallic alloys II; Proceedings of the Second Symposium, Boston, MA, Dec. 2-4, 1986. Stoloff, N.S.; Koch, C.C.; Liu, C.T.; Izumi, O. University Park, PA; Materials Research Society (1987). (CONF-8612147—).

From 2. symposium on high-temperature ordered intermetallic alloys; Boston, MA, USA (2 Dec 1986).

The as-extruded microstructures of two alloys in the two phase field consisting of Ni_3Al and NiAl in the Ni-Al phase diagram exhibit fibrous morphology and consist of Ll(2) Ni_3Al and B2 NiAl. These as-extruded microstructures can be modified dramatically by suitable heat treatments. Martensite plus NiAl or martensite plus Ni_3Al microstructures are obtained upon quenching from 1523 K. Aging of martensite at 873 K results in the recently identified phase Ni5Al, whereas aging at 1123 K reverts the microstructures to Ni_3Al plus NiAl. The microstructures with predominantly martensite of Ni5Al3 phases are brittle in tension at room temperature. The latter microstructure does not deform plastically even in compression at room temperature. However, some promise of room temperature tensile ductility is indicated by the Ni_3Al plus NiAl phase mixtures. 10 references.

40337 **Lattice location of Ta in Ni_3Al by ion channeling and nuclear reaction analysis.** Lin, H.; Seiberling, L.E.; Lyman, P.F.; Pope, D.P. pp 165-170 of High-temperature ordered intermetallic alloys II; Proceedings of the Second Symposium, Boston, MA, Dec. 2-4, 1986. Stoloff, N.S.; Koch, C.C.; Liu, C.T.; Izumi, O. University Park, PA; Materials Research Society (1987). (CONF-8612147—).

From 2. symposium on high-temperature ordered intermetallic alloys; Boston, MA, USA (2 Dec 1986).

The lattice location of Ta in Ni_3Al has been investigated using Rutherford back-scattering with channeling, and nuclear reaction analysis. An 8 MeV He-4 ion beam was directed along the 100-line crystallographic axis of the Ni75Al24Ta single crystal. A silicon surface barrier detector was used to analyze He-4 ions backscattered from Ni and Ta atoms. Neutrons generated from Al by the (Al-27)(He-4,n)(P-30) reaction were detected by a large volume liquid scintillator placed outside of the scattering chamber. Essentially all of the Ta atoms were found to be substitutional, as determined by the Ta channeling minimum yield. A comparison of the width of the channeling angular scan for Al, Ni and Ta indicated that the Ta atoms are predominantly distributed on the Ni sites. This result is in conflict with expectations based on the ternary phase diagram. 12 references.

40338 **Creep deformation of Ta modified gamma prime single crystals.** Anton, D.L.; Pearson, D.D.; Snow, D.B. pp 287-295 of High-temperature ordered intermetallic alloys II; Proceedings of the Second Symposium, Boston, MA, Dec. 2-4, 1986. Stoloff, N.S.; Koch, C.C.; Liu, C.T.; Izumi, O. University Park, PA; Materials Research Society (1987). (CONF-8612147—).

From 2. symposium on high-temperature ordered intermetallic alloys; Boston, MA, USA (2 Dec 1986).

The effect of Ta on the creep properties of Ni_3Al is investigated experimentally at 760, 871, and 982 C using 001-line oriented single crystal specimens. The strengthening due to Ta is examined in the absence of grain boundary effects, and it is found that the gamma prime single crystals do not display the classic creep response. After an incubation period, observed in all the specimens tested, either tertiary creep leading to failure or apparently classic primary, secondary, and tertiary creep is observed. In addition, the specimens exibit extremely large elongations (up to 85 percent). 14 references.

40339 **High-temperature fatigue crack propagation in P/M Ni_3Al-B alloys.** Chang, K.M.; Huang, S.C.; Taub, A.I. pp 303-308 of High-temperature ordered intermetallic alloys II; Proceedings of the Second Symposium, Boston, MA, Dec. 2-4, 1986. Stoloff, N.S.; Koch, C.C.; Liu, C.T.; Izumi, O. University Park, PA; Materials Research Society (1987). (CONF-8612147—).

From 2. symposium on high-temperature ordered intermetallic alloys; Boston, MA, USA (2 Dec 1986).

Ductile Ni_3Al-B type intermetallic alloys show a unique fatigue crack growth behavior at elevated temperatures. A crack propagation mechanism has been investigated in an experimental P/M alloy by testing the alloys with different fatigue frequencies at 400 C. The Ni_3Al-B intermetallic alloy shows a substantial time-dependece of fatigue crack growth rate when tested in air. Under a given cyclic stress intensity, an order of magnitude difference of crack growth rate was observed by decreasing the fatigue frequency. However, such a time-dependence did not occur when the alloy was tested in vacuum. It is concluded that dynamic embrittlement in an oxidation environment is the major factor controlling the fatigue crack growth in ordered Ni_3Al-B alloys at elevated temperatures. 9 references.

40340 **Structure and properties of powder metallurgy Ni_3Al alloys.** Krueger, D.D.; Marquardt, B.J.; Field, R.D. pp 309-314 of High-temperature ordered intermetallic alloys II; Proceedings of the Second Symposium, Boston, MA, Dec. 2-4, 1986. Stoloff, N.S.; Koch, C.C.; Liu, C.T.; Izumi, O. University Park, PA; Materials Research Society (1987). (CONF-8612147—).

From 2. symposium on high-temperature ordered intermetallic alloys; Boston, MA, USA (2 Dec 1986).

A Ni_3Al + B base composition and derivatives containing Hf, Zr, Nb, or Nb + Hf substitutions for Al were processed by powder metallurgy, consolidated by compaction + extrusion, and evaluated for mechanical properties. The mechanical property evaluation consisted of tensile tests performed in air and vacuum, and fatigue crack growth tests performed in air. Microstructures, test specimen fracture morphologies, and tensile and fatigue deformation features were also studied. Some of the substitutions improved certain properties, but none improved ductility. The discussion considers property-fracture morphology-deformation structure relationships. 23 references.

40341 **Microstructure and tensile properties of extruded melt-spun ribbons of iron-rich B2 FeAl.** Baker, I.; Gaydosh, D.J. pp 315-320 of High-temperature ordered intermetallic alloys II; Proceedings of the Second Symposium, Boston, MA, Dec. 2-4, 1986. Stoloff, N.S.; Koch, C.C.; Liu, C.T.; Izumi, O. University Park, PA; Materials Research Society (1987). (CONF-8612147—).

From 2. symposium on high-temperature ordered intermetallic alloys; Boston, MA, USA (2 Dec 1986).

The microstructure of extruded rods of iron-rich FeAl(B2-structure), as characterized by TEM, SEM, optical microscopy and x-ray diffractometry, consisted of elongated grains with a 111-line fibre texture containing a high dislocation density. Numerous oxide particles were found, mostly in lines which reflected the matrix flow during extrusion. In addition, some large inclusions were present. Tensile testing of annealed, relatively dislocation-free specimens as a function of increasing temperature found increasing ductility up to 900K, above which a ductility drop occurred accompanied by a change in fracture mode, from transgranular cleavage to intergranular fracture. The yield strength, which was independent of temperature up to 800K (at about 500MPa), also decreased rapidly as diffusion became more important. The predominant slip vector changed from 111-line to 100-line around 700K. 14 references.

40342 **Effects of Mo and Ti additions on the high temperature compressive properties of iron aluminides near Fe_3Al.** Diehm, R.S.; Mikkola, D.E. pp 329-334 of High-temperature ordered intermetallic alloys II; Proceedings of the Second Symposium, Boston, MA, Dec. 2-4, 1986. Stoloff, N.S.; Koch, C.C.; Liu, C.T.; Izumi, O. University Park, PA; Materials Research Society (1987). (CONF-8612147—).

From 2. symposium on high-temperature ordered intermetallic alloys; Boston, MA, USA (2 Dec 1986).

Hot compression testing has been used to examine the effects of Mo and Ti additions on the yield strength and rate of work hardening for cast alloys near Fe_3Al. A few powder processed materials have also been studied. Significant improvements in high temperature compressive properties on alloying have been related to increases in the DO3 - B2 transition temperature and the associ-

ated changes in the nature of the dislocations involved in the deformation processes. 8 references.

40343 High temperature strength of ordered and disordered Ni_4Mo. Kao, H.P.; Brooks, C.R.; Vasudevan, K. pp 335-340 of High-temperature ordered intermetallic alloys II; Proceedings of the Second Symposium, Boston, MA, Dec. 2-4, 1986. Stoloff, N.S.; Koch, C.C.; Liu, C.T.; Izumi, O. University Park, PA; Materials Research Society (1987). (CONF-8612147—).

From 2. symposium on high-temperature ordered intermetallic alloys; Boston, MA, USA (2 Dec 1986).

Experimental data on the tensile properties of ordered Ni_4Mo in the temperature range 25-1000 C are reported, and fractographs of tensile samples are presented. For specimens with the domain size 24 nm, the yield strength was 862 MPa at 25 C. With increasing temperature, the yield strength decreased to about 690 MPa at 800 C, and then decreased rapidly to about 210 MPa at 1000 C. In the ordered state, the alloy had an elongation of 1 percent or less at 25-868 C, above which it increased considerably (to 30 percent). The behavior of specimens with the domain size 3000 nm was similar, except the strength was lower. 6 references.

40344 B2 aluminides for high temperature applications. Vedula, K.; Stephens, J.R. pp 381-391 of High-temperature ordered intermetallic alloys II; Proceedings of the Second Symposium, Boston, MA, Dec. 2-4, 1986. Stoloff, N.S.; Koch, C.C.; Liu, C.T.; Izumi, O. University Park, PA; Materials Research Society (1987). (CONF-8612147—).

From 2. symposium on high-temperature ordered intermetallic alloys; Boston, MA, USA (2 Dec 1986).

The structure, phase composition, and mechanical properties of B2 FeAl and NiAl aluminides are investigated. It is noted that, in both alloys, the room temperature brittleness is of primary concern. In the case of FeAl, significant tensile ductilities of up to 8 percent have been obtained at room temperature in iron-rich alloys. In the case of polycrystalline NiAl, attempts to improve ductility have not so far been successfull. Possible solutions to this problem are examined. 88 references.

40345 Review of recent developments in iron aluminides. Mendiratta, M.G.; Ehlers, S.K.; Dimiduk, D.M.; Kerr, W.R.; Mazdiyasni, S. pp 393-404 of High-temperature ordered intermetallic alloys II; Proceedings of the Second Symposium, Boston, MA, Dec. 2-4, 1986. Stoloff, N.S.; Koch, C.C.; Liu, C.T.; Izumi, O. University Park, PA; Materials Research Society (1987). (CONF-8612147—).

From 2. symposium on high-temperature ordered intermetallic alloys; Boston, MA, USA (2 Dec 1986).

This paper presents a review of recent research conducted at the Air Force Wright Aeronautical Laboratories/Materials Laboratory to develop iron-aluminides as elevated temperature structural materials. The research consisted of investigations on the microstructure, tensile behavior, deformation, and fracture mechanisms of the DO3 and B2 iron-aluminides. Binary Fe-Al alloys with a wide range of Al contents, solid-solution ternary alloys and precipitation- and dispersion-strengthened two-phase alloys have been investigated. It is shown that iron-aluminides have a potential to be structural materials at least up to 650 C. 16 references.

40346 Room temperature tensile ductility in powder processed B2 FeAl alloys. Crimp, M.A.; Vedula, K.M.; Gaydosh, D.J. pp 499-504 of High-temperature ordered intermetallic alloys II; Proceedings of the Second Symposium, Boston, MA, Dec. 2-4, 1986. Stoloff, N.S.; Koch, C.C.; Liu, C.T.; Izumi, O. University Park, PA; Materials Research Society (1987). (CONF-8612147—).

From 2. symposium on high-temperature ordered intermetallic alloys; Boston, MA, USA (2 Dec 1986).

It has been shown that it is possible to obtain significant room temperature tensile ductility in FeAl alloys using iron-rich deviations from stoichiometry. A comparison of the room temperature tensile and compressive behaviors of Fe-50 at. pct Al and Fe-40 at. pct Al shows that FeAl is brittle at higher Al contents because it fractures along grain boundaries before general yielding. Lower aluminum contents reduce the yield stress substantially and hence some ductility is observed before fracture. Addition of boron results in measurable improvements in ductility of Fe-40 at. pct Al and is accompanied by an increase in transgranular tearing on the fracture surface, suggesting a grain boundary strengthening mechanism. Increasing the cooling rate following annealing at 1273 K results in a large increase in the yield strength and a corresponding decrease in ductility. 16 references.

40347 High temperature mechanical behavior of some advanced Ni_3Al. Hsu, S.E.; Hsu, N.N.; Tong, C.H.; Ma, C.Y.; Lee, S.Y. pp 507-512 of High-temperature ordered intermetallic alloys II; Proceedings of the Second Symposium, Boston, MA, Dec. 2-4, 1986. Stoloff, N.S.; Koch, C.C.; Liu, C.T.; Izumi, O. University Park, PA; Materials Research Society (1987). (CONF-8612147—).

From 2. symposium on high-temperature ordered intermetallic alloys; Boston, MA, USA (2 Dec 1986).

High temperature mechanical properties of various Zr- and Cr-strengthened single phase Ni_3Al are investigated, with emphasis on the ability of each element to elevate Tp, the temperature corresponding to the peak yield strength. It is observed that Zr is a very effective strengthener, more so below Tp than above it, while a combination of Cr and Zr is capable of shifting Tp to a higher temperature. The combination results in an effective improvement of the rupture strength of Ni_3Al. The strengthening mechanisms of each element are discussed in this paper. 7 references.

40348 Cluster emission from a molybdenum surface. Husinsky, W.; Pellin, M.; Calaway, W.; Burnett, J.; Schweitzer, E.; Young, C.; Gruen, D. (Materials Science and Chemistry Div., Argonne National Lab., 9200 South Cass Ave., Argonne, IL (US)). pp 70-73 of Topical meeting on microphysics of surface beams and adsorbates (Summaries). Washington, DC; Optical Society of America (1987). (CONF-870224—).

From 2. topical meeting on microphysics of surfaces, beams and adsorbates; Santa Fe, NM, USA (16 Feb 1987).

The emission process of polyatomic species, in particular the sputtering of metal-adsorbate molecules and metal clusters, have very recently been studied to an increasing extent theoretically and experimentally. However, due to the small fraction of sputtered clusters, relatively few experimental data are available at present. The interest in metal clusters arises primarily because metal cluster exhibit a strong potential as catalysts and they represent an intermediate state between atoms and metals. Often already metal clusters, build up of relatively few constituents, show features close to metals. The present investigations are concerned with the yields of neutral and ionized Mo-clusters emitted from a Mo surface during ion beam bombardment. Assuming a well know sputtering yield of Mo of 1.4, absolute sputtering yields of sputtered neutral Mo_2 and Mo_3 were obtained using Resonance and Nonresonance Ionisation Spectroscopy (RIS, NRIS). The yields of sputtered ionized atoms and clusters were obtained by SIMS. In the SARISA machine SIMS and RIS can be performed at the same time and under exactly the same conditions by simply changing the target potential and turning the ionizing lasers on or off. Under the condition, that saturation can be achieved for the ionization of the neutral species, absolute sputtering yields and ion fractions were obtained.

40349 Optical second harmonic generation studies of surface adsorption and segregation on Fe-18Cr-3Mo (110). Anderson, R.J.; Hamilton, J.C.; Foltz, G.W. (Combustion Research Facility, Sandia National Labs., Livermore, CA 94550 (US)). pp 96-99 of Topical meeting on microphysics of surface beams and adsorbates (Summaries). Washington, DC; Optical Society of America (1987). (CONF-870224—).

From 2. topical meeting on microphysics of surfaces, beams and adsorbates; Santa Fe, NM, USA (16 Feb 1987).

Optical second harmonic generation (SHG) is a promising new surface-sensitive technique that allows study of electronic structure and surface ordering for submonolayer coverages of adsorbates at pressures not accessible using more conventional surface probes. Furthermore, SHG is well-suited to probing buried interfaces between a thin overlayer and a substrate. The authors report here recent studies of adsorption and segregation on clean single crystal Fe-18Cr-3Mo (110) surfaces in ultra-high vacuum using

SHG, low energy electron diffraction (LEED), and Auger observations.

40350 **Adsorbate interactions and poisoning on Cr(110).** Shinn, N.D. (Sandia National Labs., Div. 1134, Albuquerque, NM 87185 (US)). pp 84-85 of Topical meeting on microphysics of surface beams and adsorbates (Summaries). Washington, DC; Optical Society of America (1987). (CONF-870224—). Contract AC04-76DP00789.

From 2. topical meeting on microphysics of surfaces, beams and adsorbates; Santa Fe, NM, USA (16 Feb 1987).

The chemisorption of carbon monoxide and oxygen on Cr(110) at temperatures below 150K has been studied using photoemission, vibrational and Auger Spectroscopies, and low energy electron diffraction (LEED). Direct evidence for co-adsorbate interactions which induce changes in the (1) molecular CO bonding to the chromium surface and (2) the CO dissociation energetics has been found. This work provides a microscopic picture of the "poisoning" of the Cr(110) surface for CO dissociation by electronegative oxygen atoms.

40351 **Investigation of non-magnetic iron in $Lu_2Fe_3Si_5$-type superconductors.** Xu, Y. Ames, IA; Iowa State Univ. (1987). 100p. University Microfilms Order No. 87-21,942.

Thesis (Ph. D.).

A focused study on the effect of transition-metal substitution for Fe in the compounds $Lu_3(Fe_{1-x}T_x)_3Si_5$ (where T = Cr, Mn, Co, Ni Cu, and Ru) is reported. The effect of these transition metals on the superconducting transition temperature shows that Cr, Co, Ni, and Ru all act as non-magnetic impurities. By fitting the experimental data T_c//T_{co} to Kaiser's equation, a good agreement with Kaiser's theory is obtained. The rate of suppression due to Co substitution is similar to that of Ru. Superconductivity persists (T_c = 0.49 K) even when 10 at. % Co is substituted for Fe. In contrast, Mn and Cu act as magnetic impurities and suppress T_c in a way described by the theory of Abrikosov and Gor'kov. The molar magnetic susceptibility of $Lu_3Fe_3Si_5$ does not follow a Curie-Weiss law, but rather increases slightly as temperature increases. The addition of Ru lowers the value of X(T), but the overall shape of X(T) is unchanged. In contrast, the substitution of the nominally magnetic transition metals Cr, Mn, Co and Ni for Fe causes X(T) to become more Curie-Weiss like. The magnetic susceptibility of the compound $Lu_3Co_3Si_5$ follows the Curie-Weiss law, while that of the compound $Lu_3Ru_3Si_5$ is diamagnetic. The electrical resistivity p(T) of the compound $Lu_3Fe_3Si_5$ is approximately quadratic in T at temperatures below 50 K and proportional to InT at temperature above 100 K.

40352 **Microstructural characterization of ferromagnetic materials using magnetic NDE techniques.** Ranjan, R. Ames, IA; Iowa State Univ. (1987). 121p. University Microfilms Order No. 87-16,808.

Thesis (Ph. D.).

Magnetic NDE techniques, namely, the acoustic Barkhausen noise, the magnetic Barkhausen noise, and the magnetic hysteresis curves were simultaneously used for microstructural characterization of nickel and steels. Results showed that, in nickel, the non-180° domain walls interact more strongly with dislocations than the 180° domain walls. A study of the grain-size effect on the magnetic and acoustic Barkhausen noises showed a great potential as a NDE grain-size-measurement tool. Moreover, the Barkhausen signals indicate that the 180° domain walls in nickel seem to have a stronger interaction with grain boundaries than the non-180° domain walls, as indicated by the acoustic Barkhausen signal. Based on the experimental observations, a theoretical model is being proposed to explain the grain size effect on the Barkhausen signals. The model takes into account the density of magnetic domain walls and their initial velocity, with both quantities being strongly dependent on microstructure. The acoustic and magnetic Barkhausen noises were also found to be very sensitive to the change in carbide morphology. It is proposed that the magnetic Barkhausen peak signal is caused by mainly domain nucleation and the acoustic Barkhausen peak signal due to domain growth.

40353 **Investigation of heavy-fermion and dense Kondo systems in Ce-based ternary silicides.** Lee, W.H. Ames, IA; Iowa State Univ. (1987). 102p. University Microfilms Order No. 87-16,788.

Thesis (Ph. D.).

Measurements of the magnetic contribution to the electric resistivity, static magnetic susceptibility, and low-temperature heat capacity of CePtSi are reported in this work. A logarithmic increase of magnetic resistivity is observed with the decrease of temperature in the higher-temperature region. This is one of the characteristic features of dense Kondo system. This compound has a large value of the low-temperature magnetic susceptibility and, characteristic of heavy fermion compounds, an enormous coefficient of the electronic specific heat, $\gamma \sim 800$ mJ/mol K^2. AC magnetic susceptibility measurements indicate that this compound neither orders magnetically nor is superconducting above 70 mK. To understand the nature and mechanism of the heavy-fermion compound CePtSi, a number of isostructural pseudoternary systems are investigated by studying the variations of lattice parameters, static magnetic susceptibility, and magnetic contribution to the resistivity. The magnetic properties of narrow-band metals ranging from heavy fermions to spin-fluctuation compounds to mixed-valence materials are displayed in the series $Ce(Pt_{1-x}Ni_x)Si$. Lastly, the semi-heavy-fermion system $CeSi_x$ ($1.60 \leq x \leq 1.90$) is examined.

40354 **Shock-induced solid-state chemical reactivity studies using time-resolved radiation pyrometry.** (Sandia National Labs., Albuquerque, NM (US)). pp 173-180 of Hypervelocity impact. Anderson, C.E. Elmsford, NY; Pergamon Books Inc. (1987). (CONF-861091—).

From Hypervelocity impact symposium; San Antonio, TX, USA (21 Oct 1986).

Time-resolved radiation pyrometry has been used to study materials which undergo solid-state chemical reactions due to shock loading. Shock-induced chemical reactivity in solids is fundamentally different than that in high explosives and other energetic materials because, if no volatiles are present, the reaction products end up in the condensed, rather than the vapor, state. Bulk property changes accompanying the solid-state reactions may therefore be too small to be observable with wave profile or shock-velocity measurements. However, some solid-state reactions, such as that between metallic nickel and aluminum, are exothermic enough to give rise to a measurable increase in temperature, so pyrometry can be used to detect the reactions. Unfortunately, these measurements are complicated by the large temperature increases generated by other sources. Possible mechanisms for generation of these high temperatures, and their effect on the chemical reaction, are suggested.

40355 **Application of a 100-kV electric gun for hypervelocity impact studies.** Osher, J.E.; Chau, H.H.; Gathers, G.R.; Lee, R.S.; Weingart, R.C. (Lawrence Livermore National Lab., Univ. of California, Livermore, CA (US)). pp 501-508 of Hypervelocity impact. Anderson, C.E. Elmsford, NY; Pergamon Books Inc. (1987). (CONF-861091—).

From Hypervelocity impact symposium; San Antonio, TX, USA (21 Oct 1986).

The Lawrence Livermore National Laboratory 100-kV electric gun has been used to launch flat-plate projectile for use in studies of spall and hypervelocity impact penetration of thin plates. Impactors were 0.3-mm thick Kapton with dimensions and velocities ranging from 100 mm/sup 2/ at 4 km/s to 10 mm/sup 2/ at 18 km s. A Fabry-Perot laser velocimeter, an electronic streak camera, and a flash x-ray were used as diagnostics of the flyer-plate impact on the selected specimen. Experiments generally included the recovery of the remnant specimen and fragments for detailed examination, permitting a study of incipient spall, onset of melting, and fraction fragmented. Experiments to be described include spall measurements on simple and composite target walls at normal and oblique incidence and "reverse ballistics" impacts of the thin-plate impactor on a stationary penetrator (e.g., Kapton impactors at 15 km/s incident on rods of steel, aluminum, and lead) for calibration of hypervelocity impact codes.

40356 Disintegration behavior of metal rods subjected to hypervelocity impact. Shockey, D.A.; Curran, D.R.; Osher, J.E.; Chau, H.H. (SRI International, Menlo Park, CA (US)). pp 585-594 of Hypervelocity impact. Anderson, C.E. Elmsford, NY; Pergamon Books Inc. (1987). (CONF-861091—).

From Hypervelocity impact symposium; San Antonio, TX, USA (21 Oct 1986).

The disintegration behavior of projectile rods when impacting plates at velocities above 10 km/s is largely unexplored. Possible material responses include vaporization, melting, solid state phase changes, plastic flow, shear localization, and ductile and brittle tensile fracture. Two primary difficulties have prevented experimental studies of projectile response in this velocity regime, namely the lack of a technique for accelerating a projectile to velocities above 10 km/s, and the lack of a procedure for recovering the projectile remains after impact for examination. These difficulties were overcome recently by using an exploding foil technique to drive an impactor plate and by using a reverse ballistics test arrangement to allow projectile recovery. This paper describes this experimental procedure for investigating the disintegration behavior of projectile rods under hypervelocity impact conditions, presents preliminary results for steel, aluminum and lead, and discusses requirements for computational material response models.

40357 Constitutive model used in computer simulation of time-resolved, shock-wave data. Steinberg, D.J. (Lawrence Livermore National Lab., Univ. of California, Livermore, CA (US)). pp 603-612 of Hypervelocity impact. Anderson, C.E. Elmsford, NY; Pergamon Books Inc. (1987). (CONF-861091—).

From Hypervelocity impact symposium; San Antonio, TX, USA (21 Oct 1986).

The authors designed a constitutive model for use with high-speed, hydrodynamic computer codes. The model, valid at high-deformation rates, accounts for pressure and temperature dependence of the yield strength and shear modulus, work hardening, pressure-dependent melting, Bauschiner and strain-rate effects, and spall. There are a minimum number of parameters needed to implement the model, and most can be determined without recourse to shock-wave data. At Lawrence Livermore National Laboratory, the authors assembled a library of these material properties for 44 metals, alloys, mixtures, and compounds. Shock and release data from plate-impact experiments for Be, U, Ta, Cu, 1100-0 and 6061-T6 Al, with peak stresses from 6.4 to 230 GPa, are successfully compared against calculations.

40358 Effects of vaporization on debris cloud dynamics. Trucano, T.G.; Asay, J.R. (Sandia National Labs., Albuquerque, NM (US)). pp 645-654 of Hypervelocity impact. Anderson, C.E. Elmsford, NY; Pergamon Books Inc. (1987). (CONF-861091—).

From Hypervelocity impact symposium; San Antonio, TX, USA (21 Oct 1986).

Experimental techniques are discussed for studying the debris products produced by plane shock loading of specimens to final temperatures sufficient to cause vaporization. These techniques have been applied to a study of the shock-induced vaporization of cadmium. The expansion products produced by shock reflections from a free surface were studied by allowing the debris to stagnate against a time-resolved interferometer gauge that allowed measurement of the stagnation pressure history. The experimental results were modeled in one dimension with Eulerian and Lagrangian computer wave codes utilizing detailed equations of state for cadmium. These comparisons illustrate that vaporization of cadmium occurs under essentially equilibrium conditions and that good agreement with experimental results is obtained under the assumption of instantaneous vaporization. Another observation is that the vapor expansion appears to be a centered expansion wave with a density distribution differing from the computer calculation.

40359 Microstructure and microdeformation effects on IGSCC of Alloy 600 steam generator tubing. Bruemmer, S.M.; Charlot, L.A.; Henager, C.H. Jr. Houston, TX; National Assoc. of Corrosion Engineers (1987). 12p. (CONF-870314—). National Assoc. of Corrosion Engineers, P.O. Box 218340, Houston, TX 77218.

From Corrosion '87; San Francisco, CA, USA (9 Mar 1987).

Microdeformation characteristics in Alloy 600 tubing have been examined after various tensile deformations. Microstructure developed during processing was found to control subsequent microdeformation behavior. Grain boundary carbides were the most effective source of dislocations, activating at lower macro-strains and continuing to operate at higher macrostrains than other sources. Ledges within grain boundaries, twin boundaries and matrix carbides also acted as dislocation sources. Most dislocation activity at low strains was confined to planar arrays. A conceptual model is presented to account for the effects of interfacial and matrix microstructure on microdeformation and primary-side SCC of Alloy 600 tubing. Microstructure is linked to IGSCC resistance through its influence on microdeformation behavior and the resultant crack-tip stress rate. Dislocation source activity at grain interfaces is proposed to be a critical aspect controlling IGSCC susceptibility. Effective sources such as grain boundary carbides promote crack blunting, decrease the crack-tip stress state and increase resistance to cracking.

40360 Chemical vapor deposition processes in combustion systems. Nagarajan, R. (Dept. of Mechanical and Aerospace Engineering, West Virginia Univ., Morgantown, WV (US)). pp 181-192 of Proceedings of the tenth international conference on chemical vapor deposition, 1987. Cullen, G.W. Pennington, NJ; The Electrochemical Society (1987). (CONF-8710183—).

From 10. international conference on chemical vapor deposition; Honolulu, HI, USA (1 Oct 1987).

Quantities that determine the economic viability of commercial CVD processes, e.g., deposition rate, condensate dewpoint, and composition, often dictate the lifetime, hence economics, of many power-generation and propulsion applications involving combustion of fossil fuels. In this paper, the authors present a survey of technologies where CVD has harmful consequences, and describe theoretical models to calculate the rates of vapor- and particle-deposition and of the accompanying processes of surface corrosion and "fouling". Hot corrosion and acid corrosion of marine turbine blades occur when deposited molten alkali salts and aqueous acid, respectively, dissolve the protective oxide coating and attack the alloy materials. The rate of dissolution of the oxide layer, expected to influence the rate of corrosion, is predicted to be closely linked to the vapor-deposition rate. In coal-fired heat engines, the fraction of impacting ash-material that sticks to the cooled surfaces is expected to be determined by the vapor-deposition rate of molten alkali sulfate "glue" over a wide range of surface temperatures.

40361 High-temperature corrosion in the off-gas system of a radioactive waste incinerator. Jenkins, C.F.; Peters, J.J. Houston, TX; National Assoc. of Corrosion Engineers (1987). 11p. (CONF-870314—). National Assoc. of Corrosion Engineers, P.O. Box 218340, Houston, TX 77218.

From Corrosion '87; San Francisco, CA, USA (9 Mar 1987).

Corrosion in a low-level radioactive waste incinerator off-gas system at the Department of Energy's Savannah River Plant is discussed. Severe corrosive attack and failure of an Alloy 600 part exposed to high-temperature (>1000°C) gases was observed. Rapid attack of carbon steel components, and cracking of austenitic stainless steel parts also occurred at locations where lower gas temperatures and periodic condensate exposure occurred. Investigation showed HCl, SO/sub 2/, SO/sub 3/ and phosphorus oxides were present and contributed to the failures. Mechanisms of high-temperature failure include alloy separation and reactions with phosphorus. Coupons placed in the incinerator discharge stream have provided information for selection of future materials of construction for the high-temperature system components. Several nickel- and iron-base alloys and a stainless steel with an aluminum diffusion coating were investigated.

40362 **Effect of Dy additions on microstructure and magnetic properties of Fe-Nd-B magnets.** Ramesh, R.; Thomas, G.; Ma, B.M. (Dept. of Materials Science and Mineral Engineering and Materials and Molecular Research Div., Lawrence Berkeley Lab., Univ. of California, Berkeley, CA (US)). pp 203-220 of High performance permanent magnet materials. Sankar, S.G.; Herbst, J.F.; Koon, N.C. Pittsburgh, PA; Materials Research Society (1987). (CONF-8704243—).

From High performance permanent magnet materials; Anaheim, CA, USA (23 Apr 1987).

This paper addresses the effect of Dy addition upon the magnetic properties, microstructure and microcomposition of Fe-Nd-B magnets. It is shown that increasing additions of By causes the remanence, B/sub r/ to decrease linearly. The intrinsic coercivity, iHc, increases sharply for small additions of Dy, but the increase is not proportional for higher Dy contents. The iHc increases almost linearly with the effective anisotropy field of the RE/sub 2/Fe/sub 14/B phase until the Dy content is about 10% of the total rare earth content. Above this concentration, there is a strong deviation from linearity. Various types of possible concentration profiles of the substituted rare earth are suggested. It is also argued that preferential segregation of Dy to the interfaces could be beneficial in increasing the nucleation field. Morphologically there is no apparent effect of Dy on the microstructure. However, in the 5 atomic % Dy sample, Dy rich oxides were observed. It is shown through Energy Dispersive Xray Spectroscopy (EDXS) line profiling that Dy partitions preferentially into the RE/sub 2/Fe/sub 14/B phase in all the cases. No segregation of Dy to the interphase interfaces has been detected.

40363 **Aluminum substitutions in Nd-Fe-B sintered magnets.** Chen, J.K.; Thomas, G. (Dept. of Materials Science and Mineral Engineering, Univ. of California, Berkeley, CA (US)). pp 221-230 of High performance permanent magnet materials. Sankar, S.G.; Herbst, J.F.; Koon, N.C. Pittsburgh, PA; Materials Research Society (1987). (CONF-8704243—).

From High performance permanent magnet materials; Anaheim, CA, USA (23 Apr 1987).

A microstructural and microanalytical study of aluminum substituted Nd-Fe-B sintered permanent magnets were carried out to determine the effect, if any, of aluminum on structure, composition, and magnetic properties, particularly on the observed increase in coercivity. It was found that Al enrichment occurred in the Nd-rich phase at the grain boundaries. The possible role(s) of this enrichment on the observed coercivity increase are discussed.

40364 **Effect of hydrogen on magnetic properties of quaternary Pr/sub 2/Fe/sub 14-x/Co/sub x/B compounds.** Pourarian, F.; Jiang, S.Y.; Wallace, W.E. (MEMS Dept. and Magnetic Technology Center, Carnegie-Mellon Univ., and Mellon Institute, Pittsburgh, PA (US)). pp 231-240 of High performance permanent magnet materials. Sankar, S.G.; Herbst, J.F.; Koon, N.C. Pittsburgh, PA; Materials Research Society (1987). (CONF-8704243—).

From High performance permanent magnet materials; Anaheim, CA, USA (23 Apr 1987).

The effect of absorbed hydrogen on the structural and magnetic behavior of Pr/sub 2/Fe/sub 14-x/Co/sub x/B has been investigated. Introduction of hydrogen in the host material reduces the average magnetic moment of the 3d element by — 4 to 7%. Anisotropy fields for all systems studied are significantly reduced upon hydrogenation. Evidence of spin reorientation at temperatures ranging between — 295K and 496 K for some of the hydrides is observed. Pr/sub 2/Co/sub 14/B and its hydride exhibit uniaxial anisotropy at room temperature and at 77 K. The role of hydrogen in expanding the lattices of these intermetallics and modifying their magnetic properties is discussed.

40365 **Structural multiplicity of $\Sigma = 5$(001) twist boundaries and interpretation of X-ray diffraction from these boundaries.** Oh, Y.; Vitek, V. (Dept. of Physics, Univ. of Pennsylvania, Philadelphia, PA (US)). *Acta Metallurgica;* **34**: No. 10, 1941-1954(Oct 1986).

Four different low energy structures of the $\Sigma = 5$ (001) twist boundary which possess the CSL periodicity have been found by computer simulations. These structures, three of which were also discovered in the earlier studies, generally differ in symmetry but have very similar energies. Two of these structures appear to be particularly important. The reason is that further atomistic studies show that many other low energy structures of the $\Sigma = 5$ twist boundary with repeat cells larger than the CSL cell may exist which can be regarded as composed of the units of these two structures. These calculations then suggest that the energetically most favourable structure corresponds to a random distribution of these units in the boundary. Using this assumption the intensities of a number of X-ray diffraction reflections have been evaluated and compared with the experimental observations of the X-ray diffraction patterns from the $\Sigma = 5$ boundary in gold. While serious discrepancies between calculations and experiments have been reported in the previous works as a very good agreement is achieved in the present study. The comparison of the calculated and experimental diffraction data is discussed in detail and it is concluded that the structure of the $\Sigma = 5$ boundary is most likely nonperiodic composed of two types of well defined units that are randomly distributed in the boundary.

40366 **Kinematics of $\delta \rightarrow \alpha$ and $\alpha \rightarrow \delta$ martensitic transformation in plutonium alloys.** Adler, P.H.; Olson, G.B.; Margolies, D.S. (Chemistry and Materials Science Dept., Lawrence Livermore National Lab., Livermore, CA (US)). *Acta Metallurgica;* **34**: No. 10, 2053-2064(Oct 1986).

Determination of invariant-plane-strain crystallographic solutions for martensitic transformation between the f.c.c. δ and monoclinic α phases in plutonium alloys, using three possible lattice correspondences and 53 possible lattice-invariant shear systems, identifies the most probable δ-α lattice correspondence. The operative lattice-invariant shear systems are predicted by comparison of both shape strain magnitudes and computed interfacial energies. For the $\delta \rightarrow \alpha$ transformation, twinning on (001)[100]/sub chi/ is favored, giving a (0.817, 0.538, 0.208)/sub δ/ habit and a [0.947, 0.269, 0.174/sub δ/] shape strain of magnitude m/sub 1/ = 0.324. The $\alpha \rightarrow \delta$ transformation favors slip on (111)[101]/sub δ/ giving a (0.255, 0.844, 0.471)/sub chi/ habit and [0.822, 0.446, 0355]/sub chi/ shape strain of magnitude m/sub 1/ = 0.417. Consideration of the independence of crystallographic solutions as deformation modes indicates that deformation of the monoclinic α phase via $\alpha \rightarrow \delta$ transformation plasticity will require the operation of more than one lattice correspondence, and will likely require additional deformation mechanisms to provide a sufficient number of independent deformation systems to accommodate an arbitrary shape deformation.

40367 **Microstructural aspects of strain localization in Al-Mg alloys.** Korbel, A.; Embury, J.D.; Hatherly, M.; Martin, P.L.; Erbsloh, H.W. (Academy of Mining and Metallurgy, Krakow (PL)). *Acta Metallurgica;* **34**: No. 10, 1999-2011(Oct 1986).

The literature contains a number of continuum plasticity models describing the onset of a strain localization but little definitive work which describes the microstructural transitions which accompany localization. In the present study a range of metallographic methods have been used in order to observe the progression of localization from events within single grains to the spatial organization of these events across the entire sample. The deformation mode used was cold rolling and observations were made using a variety of orientations relative to the rolling direction. It is concluded that in the Al-Mg system, localizations begins by a structural instability in the accumulated dislocation substructure and later becomes organized into macroscopic bands due to local stress concentrations. The structure of the macroscopic bands is complex. They contain some high angle boundaries suggesting that they form due to the rapid and cooperative action of a number of slip systems over distances of the order of 0.2μm.

40368 **An HVEM study of hydrogen effects on the deformation and fracture of nickel.** Robertson, I.M.; Birnbaum, H.K. (Dept. of Metallurgy and Mining Engineering, and Materials Research Lab., Univ. of Illinois, Urbana, IL (US)). *Acta Metallurgica;* **34**: No. 3, 353-366(Mar 1986). Contract AC02-76ER01198.

The mechanisms of hydrogen embrittlement of nickel have been investigated. The generation rate and velocity of dislocations

and the crack propagation rate were increased by the presence of hydrogen. The advance of transgranular cracks, in both vacuum and hydrogen, occurs by either the direct emission of dislocations from the crack tip or by a complex process of hole nucleation and growth ahead of the crack. Intergranular cracks also propagate by these mechanisms; these cracks advance along the deformation zone that follows the contour of the boundary rather than along the boundary interface. The effect of hydrogen is to decrease the stress required for crack advance and to localize the deformation. When viewed macroscopically, this confinement of plastic deformation to a narrow zone gives the impression of a brittle type feature. Hydrogen embrittlement therefore occurs by a mechanism whereby hydrogen locally enhances plastic processes rather than by a decohesion mechanism.

40369 **Proximity-induced Josephson effect and its application to heavy-fermion superconductor UBe_{13}.** Han, S. Ames, IA; Iowa State Univ. (1986). 129p. University Microfilms Order No. 87-03,708.

Thesis (Ph. D.).

A new effect between a superconductor with superconducting transition temperature T/sub CS/ and a normal metal N(T/sub cn/) (or another superconductor with T/sub cn/ < T/sub cs/) was experimentally observed and theoretically explained. That is, when S and N are brought together to form a weak link, the Josephson effect can occur in this SN system even in the temperature range T/sub cn/ < T < T/sub cs/, when the N side is in the normal state. This Josephson effect is believed to happen between the S and a region of proximity-induced super-conductivity in N near the contact with S. This is called the proximity-induced Josephson effect. The temperature dependence of the Josephson critical current I/sub c/(T) of the SN point-contact junctions have been studied experimentally. The experiments were performed on Ta/Mo, Ta/UBe_{13}, and Nb/Ta point contact, etc. The theoretical model is based on the linearized Gor'kov equation (or linearized Ginzburg-Landau equation) combined with de Gennes boundary conditions. Along with the recent discovery of the superconductivity in heavy-fermion materials $CeCu_2Si_2$, UBe_{13}, and UPt_3, the old question of p-wave pairing superconductivity is raised again (in case of the existence of strong spin-orbit scattering, it should be called odd-parity superconductivity, since in that case the wave function of Cooper pairs cannot be separated into spin part and orbit part).

3602 Ceramics, Cermets, And Refractories

REFER ALSO TO CITATION(S) 39516, 39607, 40248, 40306, 40316, 40412, 40414, 40427, 40437, 40478, 40479, 40506, 41014, 42135

40370 **(AD-A—190399/6/XAB) Transformation toughening of ceramics. Annual report No. 2, 1 September 1986-31 August 1987.** Marshall, D.B. (Rockwell International Corp., Thousand Oaks, CA (USA). Science Center). Oct 1987. 124p. (AFOSRTR—87-1854). NTIS, PC A06/MF A01.

The mechanical properties of high-toughness magnesia-partially-stabilized zirconia were found to be severely degraded by a single cooling cycle between room temperature and 196 C. In-situ Raman spectroscopy and optical interference measurements, and room temperature x-ray diffraction were used to correlate the changes in mechanical properties with structural changes; cooling to temperatures below approximately -100C caused transformation of most of the tetragonal precipitates responsible for toughening to a new phase that was stable with heating to 300 C, but at 400 C it transformed back to the tetragonal structure. After heating to 400 C the original high-toughness mechanical properties were also restored. A new approach for measuring the nature and distribution of strains within transformation zones surrounding cracks in transformation-toughened materials was demonstrated, using Mg-PSZ. The method involves measuring out-of-plane distortions adjacent to a surface-breaking crack and comparing the measurements with computed displacements. The fraction of transformation was found to be strongly varying function of distance from the crack plane.

40371 **(AD-A—190871/4/XAB) Advent of high-temperature superconducting materials: chronology of events and hallmark developments. Technical report.** Hatfield, W.E. (North Carolina Univ., Chapel Hill (USA). Dept. of Chemistry). 9 Jan 1988. 32p. (TR—28). NTIS, PC A03/MF A01.

The events that led to the discovery of high-temperature superconducting materials are reviewed in a chronological fashion, beginning with the discovery of superconductivity in mercury by H.K. Onnes. The signature properties of superconductivity are described, the basic theoretical framework necessary to understand superconductivity is briefly sketched, and the properties that lead to technological applications are discussed. Finally, the properties of LaBCO and YBCO are described, and the possibility of technological applications is discussed.

40372 **(AD-A—191140/3/XAB) Transparent glass ceramics doped by chromium(III) and chromium(III) and neodymium(III) as new materials for lasers and luminescent solar concentrators. Report for 1 May 1987-31 December 1987.** Reisfeld, R. (Hebrew Univ., Jerusalem (Israel). Dept. of Inorganic and Analytical Chemistry). 31 Dec 1987. 12p. NTIS, PC A03/MF A01.

Tunable lasers based on organic dyes are well known and their applications in various branches in physics and chemistry are well established by now. Because of degradation of the dyes under severe atmospheric conditions there is a need to replace the organic molecules by inorganic ions incorporated in a stable inorganic matrix which, will have the optical properties and the tunability range of the organic dyes but will not suffer the disadvantage of degradation. One of such materials is single-crystal alexandrite doped by trivalent chromium. The first two years of the research has shown that spectroscopic properties of Cr(III) in several singly doped glass ceramics are comparable to those of alexandrite and the preparation is much easier and more economical. Present research is investigating the possibility of extending the tunability range and optimization of the performance of the glass ceramics materials by co-doping with Nd(III).

40373 **(AD-A—191141/1/XAB) Transparent glass ceramics doped by chromium(III) and chromium(III) and neodymium(iii) as new materials for laser and luminescent solar concentrators. Progress report, 1 October 1985-31 March 1986.** Reisfeld, R. (Hebrew Univ., Jerusalem (Israel). Dept. of Inorganic and Analytical Chemistry). 31 Mar 1986. 17p. NTIS, PC A03/MF A01.

The absorption spectra of chromium(III) and nickel(II) at octahedral sites in a zirconium barium fluoride glass are analyzed and compared with vitreous and crystalline mixed oxides, suggesting slightly longer Cr-F and Ni-F distances than in crystalline fluorides. Laser properties of rare earth ions in fluoride glass (ZBLA) having composition of 57 ZrF_4, 34 BaF_2, 5 LaF_3, 4 AlF_3, or (PBLA) having composition of 36 PbF_2, 24 ZnF_2, 35 GaF_3, 3 YF_3, 2 AlF_3, for Nd(III) were calculated. Pumping efficiencies, lifetimes of excited and terminal levels and stimulated peak cross sections are presented. It is shown that multiphonon relaxations (in the case of energy difference less than 3000 cm-1) are always orders of magnitude lower in the fluoride glass than in the tellurite glass and the inhomogeneous width is consistently smaller in fluoride glass than in tellurite glass, which was chosen as a model for oxide glass. No significant difference was found for concentration quenching between the two kinds of glasses. Energy transfer between Mn(II) and Nd(III) can increase pumping efficiencies of Nd(III) lasers.

40374 **(AD-A—191142/9/XAB) Transparent glass ceramics doped by chromium(III) and chromium(III) and neodymium(III) as new materials for lasers and luminescent solar concentrators. Report for 1 October 1986-30 April 1987.** Reis, R.; Buch, A.; Bouderbala, M.; Boulon, G.; Ish-Shalom, M. (Hebrew Univ., Jerusalem (Israel). Dept. of Inorganic and Analytical Chemistry). 30 Apr 1987. 37p. NTIS, PC A03/MF A01.

Transparent glass ceramics with Cr(III) were obtained by different thermal treatments of glass with composition (mol%) 73.6 SiO_2, 11.8 Al_2O_3, 4.2. Li_2O, 7.0 ZnO, 1.6 TiO_2, 1.5 ZrO_2, 0.3 As_2O_3, 0.024 Cr_2O_3, melted under various conditions. Parallel measurements of x-ray diffraction, optical and EPR spectra reveal the different formation of gahnite from precursor glass or petalite-like phase. Laser-excited emission spectra and decay curves of Cr^{3+} in gahnite-type glass ceramics are compared with those in gahnite

crystals. The nature of the Cr^{3+} sites is determined from the positions of the emission and excitation peaks and from measurements of the decay times.

40375 **(AD-A—191143/7/XAB) Transparent glass ceramics doped by chromium(III) and chromium(III) and neodymium(III) as new materials for lasers and luminescent solar concentrators. Annual report, 1 October 1985-30 September 1986.** Reis, R.; Buch, A.; Bouderbala, M.; Boulon, G.; Greenberg, E. (Hebrew Univ., Jerusalem (Israel). Dept. of Inorganic and Analytical Chemistry). 30 Sep 1986. 54p. NTIS, PC A04/MF A01.

Transparent glass ceramics were prepared in the system Li_2O-Al_2O_3-SiO_2, MgO-Al_2O_3-SiO_2 and ZnO-Al_2O_3-SiO_2 using TiO_2, ZrO_2 and P_2O_5 as nucleators. The major crystalline phases in these samples were spinel, gahnite, beta-quartz solid solutions, and petalite-like-phase. These were doped with Cr(III) and spectroscopic properties measured. The efficiency of luminescence in these glass ceramics was very high compared to glass samples, viz. ca. 50% in beta-quartz, 75% in petalite-like-phase and close to unity in gahnite. For practical purposes the results may be important in designing luminescent solar concentrators and lasers based on Cr(III).

40376 **(AD-A—191970/3/XAB) Cluster studies of the electronic structure of Cu-O chains in high-temperature superconductors.** Chen, H.; Callaway, J.; Misra, P.K. (Louisiana State Univ., Baton Rouge (USA). Dept. of Physics). 1 Dec 1987. 4p. NTIS, PC A02/MF A01.

Pub. in Physical Review B, Vol. 36, No. 16, 8863-8865(1 Dec 1987).

The electronic structure of copper-oxygen chains present in the crystal structure of high-temperature superconductors typified by $YBa_2Cu_3O_7$ is investigated by means of self-consistent local-spin-density calculations for a cluster of $Ba_4Cu_3O_7$ in different charge states. No magnetic moments are found on the Cu ions. The nature of the chemical bonding in the cluster is discussed on the basis of the calculated charge density.

40377 **(AD-A—191979/4/XAB) Stress corrosion of ceramic materials. Annual report, 1 October 1986-30 September 1987.** Freiman, S.W.; White, G.S.; Palamides, T.R.; Balmer, M.L.; Wilson, A.M. (National Bureau of Standards, Washington, DC (USA). Ceramics Div.). 10 Jan 1988. 78p. NTIS, PC A05/MF A01.

Environmentally enhanced crack-growth data were obtained for GaAs in a number of chemical environments. The effectiveness of particular environments was predicted on the basis of existing crack-growth models. No environment was found to produce crack growth in silicon. Dielectric aging studies were conducted on capacitor ceramics. A correlation was shown between decreases in dielectric constant and reductions in indentation strength at small-indentation loads.

40378 **(CEA-CONF—9213) Moessbauer absorption in some high T/sub c/ superconductors: ^{170}Yb in YBa_2Cu_3O/sub 7-x/, ^{166}Er in $ErBa_2Cu_3O$/sub 7-x/ and ^{57}Fe in YBa_2Cu_3O/sub 7-x/.** Hodges, J.A.; Imbert, P.; Jehanno, G.; Marimon da Cunha, J.B. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Inst. de Recherche Fondamentale (IRF)). Aug 1987. 3p. (CONF-870825—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88752448/JAW.

From International conference on the applications of the Mossbauer effect; Melbourne, Australia (17 Aug 1987).

For the high T/sub c/ compound YbBa/sub 2/Cu/sub 3/O/sub 7-x/ Moessbauer absorption measurements show that magnetic ordering occurs within the Yb/sup 3+/ sublattice at 0.35K (μ/sub sat/=1.7 μ/sub B/). For ErBa/sub 2/Cu/sub 3/O/sub 7-x/ the Er/sup 3+/ sublattice orders at 0.7 K (μ/sub sat/=4 μ/sub B/). Measurements on /sup 57/Fe diluted into YBa/sub /2Cu/sub 3/O/sub 7-x/ shows that no ordered magnetic moments exist within the Cu sublattices down to at least 4.2 K.

40379 **(CEA-CONF—9220) Diffusion bonding by HIP of titanium and yttria.** Boncoeur, M.; Maire, Ph.; Valin, F. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Dept. de Physico-Chimie). 1987. 9p. (CONF-8706315—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88753904/JAW.

From International conference on hot isostatic pressing; Lulea, Sweden (15 Jun 1987).

This study concerns the diffusion bonding of a porous Y/sub 2/O/sub 3/ disc and titanium sheet. The operation is carried out in an HIP press at temperatures between 1250/sup 0/C and 1550/sup 0/C and pressures between 50 and 150 MPa. A thermodynamic study proves that no new phase can appear at the titanium - Y/sub 2/O/sub 3/ interface. Titanium nodules and villosities in the 5 microns depth of Y/sub 2/O/sub 3/ next to the interface are due to titanium infiltration in the original micropores of the oxide. Indentation tests show good Y/sub 2/O/sub 3/ - titanium bonding, the origin of which is not clearly apparent.

40380 **(CEA-CONF—9227) Potential of advanced ceramics elaborated from laser-synthetized powders.** Lihrmann, J.M.; Luce, M.; Croix, O.; Cauchetier, M. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Dept. de Physico-Chimie). 1987. 21p. (In French). (CONF-8706316—). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88753906/JAW.

From Colloquium on ceramics; Paris, France (16 Jun 1987).

Use of ultrafine powders obtained by pyrolysis of gaseous reagents with a CO/sub 2/ laser gives high tech ceramics. Initiated by Haggerty from MIT, this new method is in use at the CEA since 1985. Conditions for synthesis with a 1KW laser are presented. Lab production is nearly 40g/hr of SiC with yields of 99%. Methods for powder treatment and results of mechanical and chemical properties of the compact materials obtained are given.

40381 **(EUR—10949) Monitoring the extent of carburization by the use of magnetic techniques Part II: Measurements on various HT-Alloys carburized under different conditions.** Lang, E.; Norton, J.F. (Commission of the European Communities, Luxembourg). 1987. 83p. Commission of the European Communities Luxembourg.

The present study reports on the effect of carburization on the change in magnetic properties of various HT austenitic steels exposed to CH/sub 4//H/sub 2/ gas mixtures at temperatures between 825 and 1000/sup 0/C. Two measuring techniques were engaged to monitor the change of magnetic properties at room temperature: the Ranking-balance and the Faraday method, the latter also being used for the determination of variations of the Curie-temperature of the residual alloy matrix due to carburization. The possibility of relating the development of ferromagnetic properties to the extent of carburization is discussed. Although the ingress of carbon and the formation of carbides cause considerable changes in magnetic response, a number of factors complicate the use of such changes to quantitatively monitor the progress of carburization.

40382 **(FRCEA-TH—48) Damage under irradiation of lithium aluminate γ-LiAl0/sub 2/.** Auvray-Gely, M.H. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Dept. de Technologie; Paris-11 Univ., 91 - Orsay (France)). Nov 1987. 175p. (In French). NTIS (US Sales Only), PC A08/MF A01. Order Number DE88754057/JAW.

Electron paramagnetic resonance and optical absorption have been used to detect the point defects created by different irradiations (electrons, He/sup +/ ions, protons, X and gamma photons), transmission electron microscopy has been used to analyse samples before irradiation and observe the extended defects produced by irradiation. Defect nature is also discussed.

40383 (IC—87/273) Superconductivity, structures, ESR and SIMS-analysis of a high-T/sub c/ Y/sub 0.33/Ba/sub 0.67/Cu/sub 2.33/O/sub 3.67-σ/ compound. Porjesz, T.; Bankuti, J.; Karman, T. (International Centre for Theoretical Physics, Trieste (Italy)). Oct 1987. 11p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702677/JAW.

In a new kind of high-T/sub c/ Y/sub 0.33/Ba/sub 0.67/Cu/sub 2.33/O/sub 3.67-σ/ compound the superconducting transition comes into being between 92 and 84 K, the value of Meissner state is 68 vol.%, the change in ESR signal provides a possible proof for superconductivity, the main phase has an orthorhombic symmetry and the SIMS analysis offers quite new and valuable information on the material components. (author). 10 refs, 6 figs.

40384 (LA-UR—88-1588) Superconductor consolidation. Staudhammer, K.P. (Los Alamos National Lab., NM (USA)). 1988. Contract W-7405-ENG-36. 7p. (CONF-8806131—1). NTIS, PC A02/MF A01;1; GPO Dep. Order Number DE88010938/JAW.

From 1. industrial applications of shock processing powders; Socorro, NM, USA (1 Jun 1988).

A program to develop explosively shock consolidated monoliths of YBa_2Cu_3O/sub 7{minus}x/ ceramic superconductors has been ongoing at Los Alamos National Laboratory since last year. Shock consolidation can produce a near 100% theoretical density, bulk superconductor that does not require a post anneal in oxygen. Shock compaction is also an excellent means of creating a good electrical contact weld between the ceramic superconductor and a metal such as copper. Elimination of the post anneal and low temperature shock welding of the cladding metal are unique advantages stemming from the shock compaction processing. Successful shock compaction processing will enable production of a wide variety of complex ceramic-superconductor forms tailored for specific defense application requirements. Shock compaction can be developed into industrial manufacturing processes. DuPont now makes diamond powder this way. Shock compacted superconductor billets can be used in applications where a solid superconductor form is required (e.g., magnetic bearings, bus bar for a niobium-tin FEL SMES, motor rotors, etc.), or they can be post processed by extrusion and other swaging processes to produce textured wires and tapes for electrical current carrying applications. 11 refs., 1 fig.

40385 (PB—88-197116/XAB) Observation of the a-c Josephson effect in weak links of baycuo ceramic superconductor. Endo, T.; Shinoki, F.; Koyanagi, M.; Kasai, N. (Electrotechnical Lab., Sakura, Ibaraki (Japan)). 1987. 10p. (In Japanese). NTIS, PC E04.

Included in Bulletin of the Electrotechnical Laboratory, Vol. 51, No. 9, 21-29(1987).

Several kinds of weak links were tested in order to confirm whether the ceramic superconductor shows the Josephson effect or not. Almost all weak links made did not show the Josephson effect. The authors understand that, at present, it is not so easy to make Josephson junctions by using the bulk ceramic superconductor. However, the a-c Josephson effect was observed in an indium contact and a crack contact as well as a couple of groups reported so far.

40386 (PB—88-197124/XAB) Research on oxide superconductors at Electrotechnical Laboratory. Maekawa, S. (Electrotechnical Lab., Sakura, Ibaraki (Japan)). 1987. 16p. (In Japanese). NTIS, PC E04.

Included in Bulletin of the Electrotechnical Laboratory, Vol. 51, No. 9, 43-57(1987).

Recent research activities on oxide superconductors with higher critical temperatures than 77K are briefly reviewed, carried out by several research groups at Electrotechnical Laboratory.

40387 (PB—88-198437/XAB) Crystal structure of $La_2SrCu_2O_6$ and its relationship to the 35K and 90K high T/sub c/ superconductors. David, W.I.F.; Harrison, W.T.A. (Rutherford Appleton Lab., Chilton (UK)). Dec 1987. 17p. (RAL—87-100). NTIS, PC E03/MF E03.

The paper reports the synthesis and crystal structure of the perovskite-related phase, $La_2SrCu_2O_6$. The cation-ordering pattern, as determined by Rietveld analysis of powder neutron diffraction data differs from earlier reports. The relationship of this structure to the 35 and 90K perovskite-type superconductors is discussed.

40388 (PB—88-198445/XAB) Evidence for an isostructural phase transition and investigation of the orthorhombic strain anomaly at T/sub c/ in YBa_2Cu_3O/sub 7-x/. David, W.I.F.; Wilson, C.C.; Edwards, P.P.; Jones, R.; Harrison, M.R. (Rutherford Appleton Lab., Chilton (UK)). Dec 1987. 21p. (RAL—87-099). NTIS, PC E03/MF E03.

Powder neutron-diffraction measurements were made on the superconducting material YBa2Cu3O/sub 7-x/ (T(c)=92K) at temperatures from 10 to 150K. A second-order isostructural phase transition is found at T(c), with an anomaly in the volume expansivity leading to a determination of the specific heat anomaly, in good agreement with calorimetric determinations. Most of the volume expansivity anomaly is manifest along the c direction. There is found to be a smooth variation in the orthorhombic splitting (b-a) across the whole of this temperature range, with no evidence for a large anisotropy in the orthorhombic strain from these experiments, and thus no reason from this evidence to suppose that the superconducting wave function is strongly anisotropic within the ab plane.

40389 (PB—88-200407/XAB) Metal-semiconductor transition and antiferromagnetism in La_2CuO_4. Guo, G.Y.; Temmerman, W.M.; Stocks, G.M. (Daresbury Lab. (UK)). Jan 1988. 11p. (DL/SCI/P—571T). NTIS, PC E03/MF E03.

The spin-polarized self-consistent LMTO-ASA calculations of the total energy magnetic moment and electronic band structure of the La_2CuO_4 compound in both tetragonal and orthorhombic structures were performed. A band model to explain the semiconductivity and antiferromagnetism in La_2CuO_4 was quantitatively investigated.

40390 (UCRL—98070) Probing the electronic and defect structure of perovskite superconductors. Fluss, M.J.; Wachs, A.L.; Turchi, P.E.A.; Howell, R.H.; Jean, Y.C.; Kyle, J.; Nakanishi, H.; Chu, C.W.; Meng, R.L.; Hor, H.P.; Huang, J.Z. (Lawrence Livermore National Lab., CA (USA); Missouri Univ., Kansas City (USA); Houston Univ., TX (USA)). Feb 1988. Contract W-7405-ENG-48. 9p. (CONF-880210—1). NTIS, PC A02/MF A01; GPO Dep. Order Number DE88008349/JAW.

From 1. world congress on superconductivity; Houston, TX, USA (22 Feb 1988).

Positions, either localized or delocalized, in the perovskite superconductors are sensitive to changes in electron density accompanying the normal-to-superconducting transition. We have been using this probe in our laboratory to study the nature of this new phenomena. Our work to date, which is briefly reviewed here, has consisted of a series of lifetime studies on La/sub 1.85/Sr/sub 0.15/CuO_4 and YBa_2Cu_3O/sub 7-d/ superconducting samples, the determination of the positron wave function in the {open←quotes}perfect{close←quotes} crystal, and a direct measurement of the electron momentum density in single crystal La_2CuO_4. Several important observations have resulted from this early work: the similar response of the positron annihilation lifetime to superconductivity in both La/sub 1.85/Sr/sub 0.15/CuO_4 and $YBa_2Cu_3O_7$, and a quantitative description of the electronic structure for La/sub 1.85/Sr/sub 0.15/CuO_4 in terms of a linear combination of atomic orbital-molecular orbital (LCAO-MO) model. 3 figs., 6 refs.

40391 $Ba_3A_2PtCu_2O_{10}$ (A = Y or Ho): the crystal structure of a reaction by-product of high transition temperature superconductors with platinum metal. Geiser, U.; Porter, L.C.; Wang, H.H.; Allen, T.A.; Williams, J.M. (Argonne National Lab., IL (USA)). *Journal of Solid State Chemistry;* 73: No. 1, 243-251(Mar 1988). Contract W-31-109-ENG-38.

Mixtures of CuO, $BaCO_3$, and A_2O_3 (A = Y, rare earth) react at temperatures between 600 and 1000°C with platinum containers to produce crystals of composition $Ba_3A_2PtCu_2O_{10}$. The crystal structures of the compounds with A = Y or Ho were determined from single-crystal X-ray diffraction data. They are isostructural, monoclinic, space group C2/m, with Z = 2. Lattice param-

eters for $Ba_3Y_2PtCu_3O_{10}$ are a = 12.520(3) A, b = 5.817(1) A, c = 7.357(1) A, β = 105.53(2)°, V = 516.2(2) A^3. Lattice parameters for $Ba_3Ho_2PtCu_3O_{10}$ are a = 12.516(3) A, b = 5.813(1) A, c = 7.350(3) A, β = 105.54(2)°, V = 512.2(3) A^3. The structure of these complex oxides has the four metal ions in five distinct coordination environments; two barium sites with coordination number (CN) 8 and 11, yttrium or holmium with CN 7, platinum(IV) with CN 6, and copper with CN 5.

40392 **The new high temperature superconductors.** Cohen, M.L. (Dept. of Physics, Univ. of California, and Materials and Chemical Sciences Div., Lawrence Berkeley Lab., Berkeley, CA (US)). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* **35**: No. 1, 22-27(Feb 1988). (CONF-871006—).

From 34. nuclear science symposium and 19. nuclear power systems symposium; San Francisco, CA, USA (21 Oct 1987).

After a general description of the properties and concepts associated with superconductivity are presented, a brief review of the recent status of research of high temperature superconducting oxides is given. Suggestions are made concerning possible lines of research which may prove fruitful in choosing between alternative theories for the new phenomena. Some discussion is presented concerning the reports of possible superconductivity well above 100 K.

40393 **Time of flight neutron Rietveld refinement study at elevated temperature on a monoclinic near-stoichiometric NASICON.** Rudolf, P.R.; Clearfield, A.; Jorgensen, J.D. (Texas A & M Univ., College Station (USA)). *Journal of Solid State Chemistry;* **72**: No. 1, 100-112(Jan 1988). Contract W-31-109-ENG-38.

Time of flight neutron powder data were collected at elevated temperatures on a sample of NASICON of composition Na/sub 3.17/Zr/sub 1.93/Si/sub 1.9/O_{12}. This sample, prepared by reheating a commercially available NASICON to minimize the ZrO_2 impurity, has been previously structurally refined from room temperature neutron diffraction data collected at Argonne National Laboratory. Conductivity measurements show a cusp at ca. 170°C attributed to the monoclinic-rhombohedral transition and the purpose of this work was to explore the nature of the transition. Data runs were made at 143, 173, 202, 300, and 391°C. No evidence for a crystal system change was found. The highest temperature data sets could not be refined satisfactorily by the Rietveld method using a rhombohedral model, but rather required a monoclinic cell in space group C2/c to achieve convergence. An explanation for the conductivity cusp is given in terms of disordering of the sodium ions and a change in conduction pathways which lowers the barriers to ion movement.

40394 **Hot-roll-milled electrolyte structures for molten carbonate fuel cells.** Iacovangelo, C.D.; Pasco, W.D. (General Electric Co., Corporate Research and Development Center, Schenectady, NY (US)). *Journal of the Electrochemical Society;* **135**: No. 1, 221-224(Jan 1988).

Hot-roll-milling has been evaluated as a technique for preparing porous LiAlO/sub 2/ matrices for use as a molten carbonate fuel cell electrolyte matrix. This technique produces reliable electrolyte structures with the following characteristics: controlled pore size distribution, uniform thickness, ease of handling, and ability to be impregnated with the alkali carbonate without fracture. In-cell testing of these structures has resulted in improved cell performance over state-of-the-art hot-pressed structures.

40395 **(ORNL/tr—88/14) Highly magnetic powder.** Takashiro, Shigeaki; Yonehana, Yasunori. (Kawasaki Steel Corp., Kobe (Japan)). 1988. Contract AC05-84OR21400. Translation of Japanese Patent application No. 61-238901. 16p. NTIS, PC A03/MF A01;1.

The highly magnetic powder (Fe--magnetite) invention is a superior powder that can be used for electric wave absorber and electromagnetic shielding materials. Furthermore, since it possesses a high degree of saturated magnetization and weather resistance, it has sufficient fatigue resistance and can be used for the other purposes such as for carriers in dry copy machines.

40396 **Liquid-phase sintering of ceramics.** Marion, J.E.; Hsueh, C.H.; Evans, A.G. (Lawrence Livermore National Lab., Livermore, CA (US)). *Journal of the American Ceramic Society;* **70**: No. 10, 708-713(Oct 1987). Contract AC03-76SF00098.

Expressions for the sintering rate in liquid-phase sintering are derived for coupled-interface dissolution and liquid-phase diffusion. The analysis reveals the important role of stress gradients in the grain boundary phase and also shows that such gradients cannot be supplied by liquid-phase flow. Stress-supporting structure in the grain boundary phase is thus implied. The probable existence of such structure is revealed by diffuse dark-field scattering studies, using transmission electron microscopy, on partially sintered alumina/anorthite bodies.

40397 **Creep and densification during sintering of glass powder compacts.** Rahaman, M.N.; De Jonghe, L.C.; Scherer, G.W.; Brook, R.J. (Materials and Molecular Research Div., Lawrence Berkeley Lab., and Univ. of California, Berkeley, CA (US)). *Journal of the American Ceramic Society;* **70**: No. 10, 766-774(Oct 1987). Contract AC03-76SF00098.

The simultaneous creep and densification of glass power compacts was studied as a function of low applied uniaxial stress, temperature, and particle size. The creep rate can be expressed as the sum of the contribution from the applied stress that varies linearly with stress, and a contribution due to anisotropic densification that varies linearly with the densification rate. For a constant applied stress, the ratio of the creep rate to the densification rate is almost independent of both temperature and density. While these observations are consistent with the model of Scherer for the viscous sintering of glass, other observations show significant deviations from the model. Both the densification rate and the creep viscosity, which as an exponential dependence on porosity, show much stronger dependence on density compared with theoretical predictions.

40398 **High-pressure phase transitions in zirconia and yttria-doped zirconia.** Alzyab, B.; Perry, C.H.; Ingel, R.P. (Physics Dept., Northeastern Univ., Boston, MA (US)). *Journal of the American Ceramic Society;* **70**: No. 10, 760-765(Oct 1987).

Raman spectroscopy has been utilized to characterize the phase transformations and transition pressures in pure and doped zirconia containing 3, 4, and 5 wt% Y_2O_3. The pressure-induced transformations were investigated to over 6 GPa (at room temperature) using a diamond anvil pressure cell. Pure zirconia single-crystal samples transformed to a "new" tetragonal phase (different from the one obtained at high temperatures at atmospheric pressure) at about 4 GPa. The pressure transformation, like the temperature transition, was reversible and exhibited an approximately 0.45-GPa hysteresis at room temperature. The 3 and 4 wt% Y_2O_3 crystals underwent a monoclinic ($P2_1b$) to tetragonal ($P4_2nmc$) phase transition similar to that observed at high temperatures. This phase change was found to be irreversible on releasing the pressure. The 5 wt% Y_2O_3 at atmospheric pressure consists of a tetragonal modification in a disordered cubic matrix; a gradual, but reversible, disordering transformation of the tetragonal precipitate takes place with pressure.

40399 **Transformation toughening in ZrO_2-containing ceramics.** Heuer, A.H. (Dept. of Materials Science and Engineering, Case Western Reserve Univ., Cleveland, OH (US)). *Journal of the American Ceramic Society;* **70**: No. 10, 689-698(Oct 1987).

Transformation toughening in ZrO_2-containing ceramics is discussed. Specifically, microstructures of the three distinct types of ZrO_2-toughened ceramics are presented, after which microstructural evolution in MgO-partially-stabilized ZrO_2 (Mg-PSZ) is reviewed. The mechanical properties of such transformation-toughened ceramics are dominated by "resistance-curve" (R-curve) behavior, wherein the crack resistance increases during the course of crack propagation. Ceramics subject to R-curve behavior require a more detailed failure criterion than those subject to the usual linear elastic fracture mechanics criterion involving a critical stress inten-

sity factor, K/sub IC/ . R-curve-controlled fracture in ceramics provides a degree of very desirable flaw insensitivity, but can lead to counter intuitive relationships concerning strength, toughness, and initial flaw size. Examples of R curves of MG-PSZ with different thermal histories are given.

40400 **Steric effects in stress corrosion fracture of glass.** Michalske, T.A.; Bunker, B.C. (Sandia National Labs., Albuquerque, NM (US)). *Journal of the American Ceramic Society;* 70: No. 10, 780-784(Oct 1987). Contract AC04-76DP00789.

Previous studies show that stress corrosion crack growth in glass is controlled by chemically enhanced crack tip bond rupture reactions. The brittle nature of fracture in glass suggests that the region where bond rupture reactions occur must be on the order of the atomic spacings in the material. Crack growth kinetics and zeolite diffusion data were used to determine the relation between molecular size and reactivity at the crack tip. Crack growth rates in silica glass were measured in the presence of a series of chemical species that have comparable chemical features and systemically increasing molecular diameters. Results show that chemically active species with diameters greater than 0.5 nm are ineffective as stress corrosion agents. A comparison of crack growth results and zeolite diffusion measurements was used to conclude that the opening to the crack tip is less than or equal to 0.5 nm. This crack tip dimension is consistent with the concept of atomic scale brittle fracture in slicia glass.

40401 **Fatigue crack propagation in transformation-toughened zirconia ceramic.** Dauskardt, R.H.; Yu, W.; Ritchie, R.O. (Materials and Chemical Sciences Div., Lawrence Berkeley Lab., and Dept. of Materials Science and Mineral Engineering, Univ. of California, Berkeley, CA (US)). *Journal of the American Ceramic Society;* 70: No. 10, C-248-C-251(Oct 1987). Contract AC03-76SF00098.

Fatigue crack propagation under tension-tension loading is observed in transformation-toughened partially stabilized zirconia (PSZ) ceramic containing 9 mol% MgO. Such subcritical crack growth behavior is demonstrated to be cyclically induced, based on a comparison with behavior under sustained loading (at the maximum load in the fatigue cycle) and at varying cyclic frequencies. Crack extension rates, which are measured as a function of the cyclic stress intensity range ΔK over the range 10^{-10} to 10^{-6} mcycle, are found to be load ratio dependent and to show evidence of fatigue crack closure, similar to behavior in metals. Cyclic crack growth rates are observed at ΔK levels as low as 3 MPa . $m^{1}2$ and are typically many orders of magnitude faster than reported data on environmentally assisted, subcritical crack growth in PSZ under sustained-load conditions.

40402 **SiC reinforced aluminide composites.** Brindley, P.K. pp 419-424 of High-temperature ordered intermetallic alloys II; Proceedings of the Second Symposium, Boston, MA, Dec. 2-4, 1986. Stoloff, N.S.; Koch, C.C.; Liu, C.T.; Izumi, O. University Park, PA; Materials Research Society (1987). (CONF-8612147—).

From 2. symposium on high-temperature ordered intermetallic alloys; Boston, MA, USA (2 Dec 1986).

The tensile properties of SiC fiber, Ti_3Al+Nb and SiC/Ti_3Al+Nb composite have been determined from 300 to 1365 K. The composite results compared favorably to rule-of-mixtures (ROM) predictions in the intermediate temperature regime of 475 to 700 K. Deviations from ROM are discussed. Composite tensile results were compared on a strength/density basis to wrought superalloys and found to be superior. Fiber-matrix compatibility was characterized for the composite at 1250 and 1365 K for 1 to 100 hours. 8 references.

40403 **Measurement of agglomerate strength distribution in agglomerated powders.** Ciftcioglu, M. Ames, IA; Iowa State Univ. (1987). 166p. University Microfilms Order No. 87-21,875.

Thesis (Ph. D.).

A new technique for measuring the strength distributions of powder agglomerates was developed. It involves the use of a calibrated ultrasonic sound field. The strength distributions of hollow glass microspheres were determined independently by mercury porosimetry, and then used to calibrate the sound field; breaking pressures from 1 to 76 MPa could be obtained by varying the energy input to the ultrasonic transducer. Agglomerate strength distributions were measured for a variety of yttria and yttria-stabilized zirconia powders, which were prepared by solution-precipitation methods. Different preparation methods were used in order to obtain powders containing agglomerates with different characteristics. Special yttria powders containing agglomerates of 0.1 μm, spherical, monosize spheres were also prepared. BET surface area, tap density, pressed density, compaction curves, and mercury intrusion curves were also obtained. The powders were pressed and sintered, and the sintered density measured for each pellet. Quantitative correlation between agglomerate strength and sintered density was shown experimentally for the first time.

40404 **Interpretation of the temperature dependence of conductivity in superconducting oxides.** Thorn, R.J. (Chemistry and Material Science Divisions, Argonne National Lab., Argonne, IL (US)). pp 25-37 of Chemistry of high-temperature superconductors. Nelson, D.L.; Whittingham, M.S.; George, T.F. Washington, DC; American Chemical Society (1987). (CONF-8708179—).

From Symposium on the chemistry of high temperature superconductors; New Orleans, LA, USA (30 Aug 1987).

The diverse variations of the conductivities vs. temperature observed in oxide superconductors can be interpreted with a model based on microcanonical ensembles of a semiconductor and a semimetal originally derived for organic radical cation salts. The equation for the model transverses, through the variations of the Fermi and gap energies and a scattering factor, the range from a semiconductor to a semimetal and defines quantitatively the boundary between the two corresponding to the optimum superconducting state. Therein it describes quantitatively the roles of composition and pressure in determining the onset of the superconducting state. An examination of the published resistivity curves vs. temperature for La/sub 2-x/A/sub x/CuO/sub 4-δ/ and YBa/sub 2/Cu/sub 3/O/sub 6.5+δ/ yield information consistent with the model and relevant to the defects and range of homogeneity needed for phase diagrams.

40405 **Ceramic composites by chemical vapor infiltration.** Stinton, D.P. (Metals and Ceramics Div., Oak Ridge National Lab., P.O. Box X, Oak Ridge, TN (US)). pp 1028-1040 of Proceedings of the tenth international conference on chemical vapor deposition, 1987. Cullen, G.W. Pennington, NJ; The Electrochemical Society (1987). (CONF-8710183—).

From 10. international conference on chemical vapor deposition; Honolulu, HI, USA (1 Oct 1987).

Composites consisting of silicon carbide matrices reinforced with continuous ceramic fibers are being developed for high-temperature structural applications. Chemical vapor deposition (CVD) techniques are very effective in fabricating composites with high strengths and exceptional fracture toughness. Mechanical properties of infiltrated composites are controlled by the strength of the interfacial bond between the fibers and matrix. This paper describes two CVD techniques and reviews the models being developed to better understand and control the infiltration process.

40406 **A diffusional phase transformation in ZrO/sub 2/-4wt% Y/sub 2/O/sub 3/ induced by surface segregation.** Chaim, R.; Brandon, D.G.; Heuer, A.H. (Dept. of Metallurgy and Materials Science, Case Western Reserve Univ., Cleveland, OH (US)). *Acta Metallurgica;* 34: No. 10, 1933-1940(Oct 1986).

Annealing 4 wt% Y/sub 2/O/sub 3/-containing tetragonal ZrO/sub 2/ polycrystals (Y-TZP) caused surface segregation of an Fe-rich silicate, which led to dissolution of the near-surface tetragonal ZrO/sub 2/ grains and re-precipitation of larger Y/sub 2/O/sub 3/-rich (10 wt%) cubic ZrO/sub 2/ grains. After this reaction, the surface glass was essentially Y/sub 2/O/sub 3/-free.

40407 **Toughening behavior in ceramics associated with the transformation of tetragonal ZrO/sub 2/.** Becher, P.F. (Metals and Ceramics Div., Oak Ridge National Lab., Oak Ridge, TN (US)). *Acta Metallurgica;* **34**: No. 10, 1885-1892(Oct 1986).

The contribution of the stress-induced phase transformation ZrO/sub 2/ to the fracture toughness of ceramics is described in terms of the zone size, the critical transformation stress and the influence of these parameters on the tetragonal to monoclinic transformation. For example in partially stabilized zirconia (PSZ), the ΔK/sub IC//sup T/ is shown to depend upon the martensite start (M/sub s/) temperature, which can be altered by the solute content and the particle or precipitate size. This behavior is consistent with the thermodynamics of the transformation. Experimental data correspond to the behavior predicted for various systems toughened by the addition of tetragonal ZrO/sub 2/ [e.g. PSZ and Al/sub 2/O/sub 3/-Z/sub 4/O/sub 2/(Y/sub 2/O/sub 3/). The stress required to transform the ZrO/sub 2/ is also modified by residual stresses due to the mismatch in matrix and particle (esp. thermal expansion) properties in the composite systems. The total residual stress acting on a particle is the sum of the particle's internal stress and the stress field of neighboring particles, and as a result, the total residual stress increases with volume fraction of ZrO/sub 2/ (V/sub f/). In the case of the Al/sub 2/O/sub 3/-ZrO/sub 2/ composites the pertinent stresses are tensile in character and thus promote the ZrO/sub 2/ transformation as V/sub f/ increases] For each level of Y/sub 2/O/sub 3/ in the ZrO/sub 2/, ΔK/sub Ic//sup T/ then goes through a maximum with increase in V/sub f/ at a value of V/sub f/ where σ/sub R//sup T/ - σ/sub C//sup T/. The critical transformation stress is thus described for different levels of solute (e.g. Y/sub 2/O/sub 3/) in the ZrO/sub 2/. The dependence of ΔK/sub Ic//sup T/ upon (σ/sub C//sup T/ - σ/sub R//sup T/) obtained is found to agree with the predicted behavior.

3606 Other Materials

REFER ALSO TO CITATION(S) 39200, 39354, 39409, 39554, 39650, 39751, 40089, 40090, 40147, 40302, 40377, 40405, 40510, 40548, 40593, 40594, 40619, 40638, 40671, 40679, 40731, 40751, 40752, 40770, 41027, 42134, 42134, 42134

40408 **(AD-A—190795/5/XAB) Electronic structure, elementary excitations, optical and transport properties of semiconductor superlattices. Final report, 1 August 1984-31 October 1987.** Quinn, J.J. (Brown Univ., Providence, RI (USA)). Dec 1987. 10p. NTIS, PC A02/MF A01.

The following areas were studied: (1) Collective Charge Density Excitation in Artificially Structured Materials; (a) Intra-and Intersubband Excitations of a Semiconductor Superlattice; (b) Plasmon Bands of Periodic Metallic Heterostructures; (c) Surface Plasmons in Artificially Structured Solids; (d) Raman and Inelastic Electron Energy Loss Spectroscopy due to Collective Charge Density Excitation; (e) Plasmon in Quasi-Periodic Layered Electron Gas Systems; (2) Impurity Levels, Excitons, Phonons, and Magnetic Polarons in Quantum Well Structures; (3) The Single Particle Self-Energy in Layered Electron Gas Systems; (4) The Quantum Hall Effect. The results appear in 58 publications.

40409 **(AD-A—190994/4/XAB) Adhesive bonding of thermoplastic composites. Periodic report No. 4, August-December 1987.** Kinloch, A.J.; Kodokian, G.K. (Imperial Coll. of Science and Technology, London (UK). Dept. of Mechanical Engineering). 15 Jan 1988. 16p. NTIS, PC A03/MF A01.

Successful adhesive bonding of thermoplastic composites was achieved using corona discharge treatment. Both a physical and chemical analyses was carried out to determine the effects of corons treatment. These analyses confirm that corona treatment increases the wettability and intrinsic adhesion of the materials analyzed by introducing specific chemical groups.

40410 **(AD-A—190997/7/XAB) Modeling techniques for composites subjected to rapid thermal-pulse loading. Final report, July 1986-February 1987.** Mueller, A.C.; Lin, K.Y.; Holsapple, K.A. (Flow Research Co., South Kent, WA (USA)). Feb 1987. 54p. (FLOW-RR—392). NTIS, PC A04/MF A01.

Composite structures may be subjected to sources of thermal energy including x rays from nuclear weapons, lasers, and particle beams. This study addresses the need for analysis tools to predict the effects of rapid thermal pulse loading on aerospace composite materials that contain delaminations. A major objective of this study is to determine the feasibility of providing such an engineering design tool. Existing codes were modified to analyze the stress wave generation and its subsequent interaction with a delamination. The finite-difference model for simulation of the stress wave initiation includes the thermomechanical coupling and a general equation-of-state model to account for phase changes. A singular finite element model is employed to account for the stress singularity near a delamination within the anisotropic composite plies. Tests were conducted to ensure that the singular element is applicable to the present problem.

40411 **(AD-A—191056/1/XAB) Disclination structures in carbon and graphite. Technical report.** White, J.L. (Aerospace Corp., El Segundo, CA (USA). Materials Sciences Lab.). 31 Dec 1987. 31p. (TR—0086(6728-01)-1). NTIS, PC A03/MF A01.

Carbon materials are structurally unique, owing to their relationship to liquid crystals. Pyrolysis of precursors that pass through a liquid crystalline (mesophase) state is the process by which most carbons form. The lamelliform morphologies that are locked in as the carbonaceous mesophase hardens lack grain boundaries but possess disclinations as their most prominent structural feature. Practical materials, ranging in value from petroleum coke to mesophase carbon fiber, form while the mesophase undergoes deformation, and the disclinations can react extensively before they are entrapped by hardening. Thus, most carbons and graphites may be regarded as mesophase fossils with disclination-dominated microstructures that vary with the nature and extent of deformation and with the time allowed for the disclinations to react and relax before hardening.

40412 **(AD-A—191228/6/XAB) Micro-Raman analysis of dielectric optical thin films. Final technical report, 1 May 1985-30 September 1987.** Schmid, A. (Rochester Univ., NY (USA). Lab. for Laser Energetics). 7 Jan 1988. 24p. NTIS, PC A03/MF A01.

Wide-band-gap dielectric thin films up to 6 micrometer in thickness are characterized by spontaneous and stimulated Raman-gain microscopy. Materials surveyed are aluminum oxide, yttrium oxide, zirconium oxide, hafnium oxide, and tantalum oxide. 1-micrometer-sized surface defects on Y_2O_3 are investigated.

40413 **(AD-A—191267/4/XAB) Bimodular behavior and crack closure in compression in a brittle material.** Feldman, L.A. (Aerospace Corp., El Segundo, CA (USA). Materials Sciences Lab.). 30 Sep 1987. 22p. (TOR—0086(6728-02)-3). NTIS, PC A03/MF A01.

A vibrating-beam method was used to determine the elastic modulus of graphite rods. The frequency and apparent modulus were determined as a function of compression end loading. Following fracture of the rod, the frequency and apparent modulus were decreased. At a compression and loading of about 0.83 MPa (120 psi), crack closure was sufficient for the fractured rod to behave similarly in vibration to the unfractured rod. Thus, the fractured material behaves in a bimodular fashion and crack closure can be achieved to enable unimpeded stress transfer across the fracture surface during vibration.

40414 **(AD-A—191271/6/XAB) Effects of 67.5-MeV electron irradiation on Y-Ba-Cu-O and Gd-Ba-Cu-O high-temperature superconductors. Master's thesis.** Sweigard, E.L. (Naval Postgraduate School, Monterey, CA (USA)). Dec 1987. 84p. NTIS, PC A05/MF A01.

High-temperatures superconductors ($YBa_2Cu_3O(6+delta)$ and $GdBa_2Cu_3O(6+delta)$, both with delta < or = 1) with T/sub c/ approx. 92K and manufactured at the University of Houston were irradiated with 67.5-MeV electrons at fluences of 10^{13}, 10^{14}, 10^{15} and 5 x 10^{15} electrons/sq. cm. The irradiation effects were studied by analyzing resistance versus temperature curves developed using the four-probe resistance measuring technique. The YBaCuO sample showed irradiation (.3 Mrad) and an isolated fail-

ure to achieve total superconductivity above 77K after the 10 to the 14th irradiation (3 Mrad). The same sample re-established its high-Tc (92K) after subsequent irradiations. This was presumed to indicate microscopic damage to superconducting channels. It also displayed granular crumbling in the vicinity of the electrical contacts. This was interpreted as an effect of the differences in thermal expansion rates between the contacts and the superconductor.

40415 (AD-A—191297/1/XAB) Investigation of nonlinear optical behavior of semiconductors for optical switching. Volume 1. Final report, 1 October 1984-30 September 1986. Simmons, J.H. (Florida Univ., Gainesville (USA). Dept. of Materials Science and Engineering). 30 Sep 1987. 255p. NTIS, PC A12/MF A01.

Studies were conducted on semiconductor-doped filter glasses that have been observed to exhibit third order optical nonlinearity. This NLO behavior switches on and off in sub-picosecond times. However, the switching time, the NLO coefficient and the operating temperature are affected by the microstructure of the precipitated CdS and CdSe semiconductors. Studies were conducted to examine the crystal microstructures developed in these filter glasses and to correlate them with the optical properties of the semiconductors. There appears to be a potential for an increase in NLO coefficient by a factor of 10 to 1000 with the development of a suitable microstructure. Results and implications of the studies are presented. Studies on thin films of semiconducting CdS showed that microstructure can be controlled by suitable sputtering conditions. Strong exciton transitions were observed and have a high potential for NLO behavior. Composite thin films of CdS semiconducting crystals confined in a glass matrix were formed by co-evaporation. Studies of the phase separation behavior of fluoride glasses were continued in the system: CdF_2, LiF, AlF_3, PbF_2. Two levels of phase separation were observed, consisting of a large microstructure of isolated spheres 3-10 micrometers in diameter, and a very small interconnected microstructure resulting from secondary phase separation.

40416 (AD-A—191423/3/XAB) MBE of HgCdTe. Interim report No. 1. Golding, T.D. (Cambridge Univ. (UK). Cavendish Lab.). 1987. 5p. NTIS, PC A02/MF A01.

Availability: Document partially illegible.

A feasibility study of indium antimonide/cadmium telluride superlattices and InSb/CdTe/InSb barrier systems for study of vertical transport properties has been conducted. Auger depth profiles of four-period InSb/CdTe (200/200A) SL grown at 300, 200, and 75 C indicate severe interdiffusion and/or growth problems with this system. CdTe can be successfully grown within the temperature range 180-300 C. InSb is typically grown between 300-400 C. Thus at present the overlap in the InSb and CdTe growth temperature windows is around 300 C. It is also apparent that there is very little incorporation of cadmium. This is believed to be a consequence of the growth mechanism during the growth of an InSb/CdTe SL whereby the tellurium bonds with In resulting in Cd-deficient layers. Once the available indium has bonded with the tellurium, stoichiometric CdTe will then prevail. It is apparent that in order to obtain abrupt InSb/CdTe heterojunctions a full study of the parameters during growth will have to be examined.

40417 (AD-A—191547/9/XAB) Investigation of II-VI superlattice deposition by laser photochemical techniques. Annual report, 26 November 1986-24 November 1987. Stirn, R.J.; Nouhi, A.; Radhakrishnan, G. (Jet Propulsion Lab., Pasadena, CA (USA)). Jan 1988. 34p. NTIS, PC A03/MF A01.

The objectives of this research program are to develop metalorganic chemical vapor deposition (MOCVD) techniques for manganese-bearing II-VI ternary compounds epitaxially grown on gallium arsenide substrates, and to explore the usefulness of uv-laser assist for deposition for superlattice structures of wider bandgap II-VI binary compounds. For the first time, high-quality single-crystal (111) Cd1-xMnxTe was grown by conventional MOCVD on (100) GaAs wafers with high resolution cross-selectional transmission electron microscopy was used for structural characterization, showing atomically abrupt interfaces, but different microstructures within the epi-film depending on growth temperature. Uv adsorption spectra of a number of metalalkyl sources for cadmium, zinc, selenium, and tellurium were measured and optical adsorption cross sections calculated. Preliminary depositions of cadmium telluride and zinc telluride films on glass substrates were mase at 200 C with uv excitation provided by an excimer gas laser operating at 193 nm and by using a parallel beam geometry. Some optical and x-ray diffraction data are presented as well as a description of the low-pressure laser photochemical deposition system.

40418 (AD-A—191725/1/XAB) Anomalous temperature-dependent negative magnetoresistance in pregraphitic carbons. Report for 1 September 1986-31 August 1987. Sugihara, K.; Dresselhaus, M.S. (Massachusetts Inst. of Tech., Cambridge (USA)). 30 Oct 1987. 4p. NTIS, PC A02/MF A01.

Some kinds of pregraphitic carbons exhibit temperature-dependent negative magnetoresistance even at helium temperatures. To account for this anomalous behavior, two assumptions were introduced. First, the sample is composed of an assembly of many thin films nearly independent of each other elastically. Second, ionized impurity scattering makes an important contribution to the resistivity. Rayleigh waves with small damping and small sound velocity propagate through each film and the scattering due to the Rayleigh-wave phonons gives rise to a carrier relaxation rate that decreases as the square of the thin-film thickness. Since the screening length of an ionized impurity potential decreases with magnetic field, this process leads to a negative magnetoresistance. Combining these two effects, the qualitative features of the temperature-dependent negative magnetoresistance can be explained within the framework of Bright's Theory.

40419 (AD-A—191726/9/XAB) Electrical conduction in thin-film carbons. Report for 1 September 1986-31 August 1987. Sugihara, K.; Dresselhaus, M.S. (Massachusetts Inst. of Tech., Cambridge (USA)). 30 Oct 1987. 3p. NTIS, PC A02/MF A01.

The interaction between electrons and phonons in a thin carbon film is investigated. Sound-wave propagation in a thin carbon film has a small sound velocity and small damping. The scattering of electrons by phonons associated with the Rayleigh wave is found to be responsible for the anomalous temperature dependence of the resistivity and for the negative magnetoresistance of pregraphitic carbons at low temperatures.

40420 (AD-A—191727/7/XAB) Electron-Rayleigh wave interaction in thin-film carbons. Report for 1 September 1986-31 August 1987. Sugihara, K. (Massachusetts Inst. of Tech., Cambridge (USA)). 30 Oct 1987. 4p. NTIS, PC A02/MF A01.

Sound-wave propagation in thin-film carbon is investigated in the long-wavelength approximation. Strain-free and stress-free boundary conditions lead to the same solution. The Rayleigh wave, with a small damping constant and with polarization perpendicular to the layer planes, has a small sound velocity. Since the long-wavelength phonon energies associated with this wave are very small, these phonons are readily excited even at very low temperatures. Furthermore, those phonons strongly scatter carriers at low temperatures. Of particular interest for transport properties is the determination of the carrier relaxation time for very thin-film thicknesses. These phonons are also responsible for the temperature dependence of the negative magnetoresistance of pregraphitic carbons at low temperatures.

40421 (AD-A—191996/8/XAB) Center for Thin-Film Studies. Annual report, 1 October 1986-1 October 1987. Shannon, R.P.; Gibson, U.J. (Arizona Univ., Tucson (USA). Optical Sciences Center). 15 Nov 1987. 136p. NTIS, PC A07/MF A01.

This report covers the first year of operation of the URI Thin Film Center (TFC), and describes a diverse array of studies on thin-film materials, substrates, and their processing and analysis. Individual efforts are highlighted in sections on nucleation studies, ion-assisted deposition, Rutherford backscattering spectrometry, Brillouin scattering, a continuum theory of the evolution of structure in thin films, a study of polishing parameters relevant to the preparation of substrates, and the setup of a characterization facility for the Center.

40422 **(ANSTO/E—665) Rapid thermal annealing of neutron transmutation doped silicon.** Lawson, E.M.; Lee, P.J. (Australian Nuclear Science and Technology Organisation, Lucas Heights). Oct 1987. 11p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703091/JAW.

Rapid thermal annealing of neutron transmutation doped silicon wafers is shown to be an alternative to the normal furnace annealing procedure. A prototype incoherent light, rapid thermal annealing, 4.5 kW furnace has been constructed which can raise the temperature of 75mm diameter silicon wafers to 1120 deg C. Successful annealing is demonstrated by comparing the resistivities of the wafers with those from the furnace annealed standards. Deep level transient spectrometry has been performed to show that there are no electrically active deep level impurities present. Although there is evidence for crystalline slip, it does not appear to affect the results.

40423 **(ANSTO/E—668) Neutron transmutation doping of silicon for the production of radiation detectors.** Alexiev, D. (Australian Nuclear Science and Technology Organisation, Lucas Heights). Nov 1987. 14p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703094/JAW.

P-type silicon was doped by neutron transmutation (NTD-Si) to produce high resistivity n-type silicon suitable for the production of surface barrier radiation detectors. Deep level transient spectroscopy (DLTS) analysis showed no remnant traps following annealing (850 deg C) of the NTD-Si in the presence of a phosphosilicate glass getter. Surface barrier radiation detectors constructed from this material showed no significant charge trapping and compare favourably with those constructed of float-zone (FZ) Si.

40424 **(ANSTO/E—670) Neutron transmutation doping of gallium arsenide.** Alexiev, D. (Australian Nuclear Science and Technology Organisation, Lucas Heights). Dec 1987. 14p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703095/JAW.

Neutron transmutation doping (NTD) was studied as a means of compensating p-type Cd-doped GaAs. By introducing specific donor concentrations, the net acceptor level was measured and showed a progressive reduction. The NTD constant K = 0.32 donor atoms.cm/sup 3/ per cm/sup 2/ was also measured. Radiation damage caused by neutron bombardment was annealed and no additional traps were generated.

40425 **(BDX—613-3957) Expandable polystyrene bead foam replacement: Final report.** Fossey, D.J. (Allied-Signal Aerospace Co., Kansas City, MO (USA). Kansas City Div.). Jun 1988. Contract AC04-76DP00613. 41p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88012404/JAW.

Samples of three different expandable polystyrene bead material, obtained from two suppliers, were evaluated as replacement material for a discontinued product used for the last 10 years as an encapsulant for electronic packages. Large quantities of two of the materials were purchased for more detailed evaluation. Compressive and tensile properties of these materials were determined as a function of foam density and test temperature. These properties were found to be equivalent to the properties of the current material. Pre-expansion and screening processes were determined to be the same as those currently required. Both new materials were found to be more thermally stable during the fusion cycle, which should help in the encapsulation of larger electronic packages. Acceptable foam could be molded from both, with a lower volatile content. This will allow for longer shelf life of the pre-expanded beads and reduce their scrap rate. Tests conducted at Sandia National Laboratory Albuquerque (SNLA) revealed no obvious material incompatibility with one of the new materials (Type A). Type A material has been approved to replace the current material. Plans are to add the second new material (Type B) as an alternate. Type A material has been purchased and is currently being used in production. This change-over occurred without any production delays. 7 refs., 15 figs., 11 tabs.

40426 **(CONF-880625—1) Multistress aging of polymer films.** Brinkman, C.R.; McCoy, H.E. (Oak Ridge National Lab., TN (USA)). 1988. Contract AC05-84OR21400. 4p. NTIS, PC A02/MF A01;1; GPO Dep. Order Number DE88008094/JAW.

From Institute of Electrical and Electronics Engineers symposium on electrical insulation; Boston, MA, USA (5 Jun 1988).

An experimental facility has been developed in which polymer film specimens can be simultaneously exposed to mechanical, electrical, and thermal stresses. The test environment is transformer oil at 90{degree}C. The mechanical stress can be varied over a wide range, and the potential is regulated at about one-half the breakdown voltage. The facility can accommodate eight specimens run at the same time at various mechanical stresses, with or without an applied potential. The temperature of all eight specimens must be the same, and the applied potential must either be zero or the same value. 1 ref., 7 figs., 2 tabs.

40427 **(DOE/ER/45283—2) [X-ray studies of strain, interface and impurities in semiconductors]: Technical progress report for the period July 1, 1987-June 30, 1988.** Kao, Y.H. (USDOE, Washington, DC). 1988. Contract FG02-87ER45283. 10p. NTIS, PC A02/MF A01;1; GPO Dep. Order Number DE88012460/JAW.

Our primary approach is to make use of x-rays from synchrotron radiation for investigating various structural effects in semiconductors and high-Tc superconductors. Several different material systems were studied. These experiments include: probing the microstructure, optical constants, and interfacial roughness in ZnSe/GaAs, AlGaAs/GaAs, $CoSi_2$/Si(111), InAs/GaAs heterojunctions; studies of x-ray fluorescence from layer-structure materials (heterojunctions and superlattices) both as a physical phenomenon and as an experimental tool; studies of total electron yield due to x-ray excitation; investigation of high-Tc superconducting materials by atomic substitution and by x-ray absorption studies; and measurements of lattice strain in As-implanted Si using double crystal topography.

40428 **(DOE/NE/44139—34) Preliminary results of durability testing with borosilicate glass compositions.** Adel-Hadadi, M.; Adiga, R.; Barkatt, Aa.; Barkatt, Al.; Feng, X.; Finger, S.; Freeborn, W.P.; Macedo, P.B.; Mohr, R.; Montrose, C.; Pegg, I.L.; Saad, E.; Sousanpour, W. (Catholic Univ. of America, Washington, DC. Vitreous State Lab.). 28 Jan 1987. Contract AC07-81NE44139. 159p. NTIS, PC A08/MF A01;1; GPO Dep. Order Number DE88009560/JAW.

This is a report on the first year of research conducted at the Vitreous State Laboratory of the Catholic University of America in support of the West Valley Demonstration Project. One objective is the vitrification of liquid waste generated by previous nuclear fuel reprocessing. This work has been directed principally at the problem of glass composition optimization. This has necessitated the development of a coordinated program of glass production, durability measurements, and processability assessment. A small-scale continuous melter has been constructed for melting uranium and thorium containing glasses and for studying glass processing characteristics. Glass viscosities have been measured over a range of temperatures. A large number of glasses have also been produced in small crucible melts. Glass durability has been assessed using four types of leach tests: MCC-3, MCC-1, IAEA/ISO, and pulsed-flow tests. Extensive data from these tests are reported. The data have led to the design of very durable glasses (comparable to the Savannah River Laboratory Defense Waste Reference Glass) which have the requisite waste loading and processing characteristics. 14 refs., 4 figs., 77 tabs.

40429 **(DOE/PC/91024—T5) Characterization and fundamental studies on CuO sorbent materials to determine attrition mechanisms on substrate gamma alumina: Technical progress report No. 4 for the period June 23-September 23, 1987.** Mote, J.D.; Eucker, P.; Naziripour, A.; Zillman, W. (Denver Univ., CO (USA). Dept. of Engineering). 1987. Contract AC22-86PC91024. 11p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88008352/JAW.

More detailed analysis of the impact properties of the sorbent materials in their various states were conducted during this quarter. Particle size determinations of sorbent spheres in various states were made by x-ray line broadening measurements. The materials examined previously indicate an increase in the particle size after sorption-desorption in the pilot facility. Further analysis has found the size difference to be minimal. Careful examination of the surface particles subjected to threshold fracture loads, both statically and dynamically, reveal flattened areas due to local crushing of the spheres. Measurement of the diameter of these deformed areas at the fracture load is impracticable, hence the areas were determined for a number of unbroken samples subjected to threshold fracture loads and an average value was used to estimate the fracture stresses. 10 figs., 1 tab.

40430 **(EUR—10803) Cements in radioactive waste management. Characterization requirements of cement products for acceptance and quality assurance purposes.** Rahman, A.A.; Glasser, F.P. (Commission of the European Communities, Luxembourg). 1987. 193p. NTIS (US Sales Only), PC A09/MF A01. Order Number DE88752438/JAW.

Cementitious materials are used as immobilizing matrices for low (LLW) and medium-level wastes (MLW) and are also components of the construction materials in the secondary barriers and the repositories. This report has concerned itself with a critical assessment of the quality assurance aspects of the immobilization and disposal of MLW and LLW cemented wastes. This report has collated the existing knowledge of the use and potential of cementitious materials in radioactive waste immobilization and highlighted the physico-chemical parameters. Subject areas include an assessment of immobilization objectives and cement as a durable material, waste stream and matrix characterization, quality assurance concepts, nature of cement-based systems, chemistry and modelling of cement hydration, role and effect of blending agents, radwaste-cement interaction, assessment of durability, degradative and radiolytic processes in cements and the behaviour of cement-based matrices and their near-field interactions with the environment and the repository conditions.

40431 **(IAE—4396/11) X-ray diffraction texture studies of graphite articles.** Skvortsov, V.V.; Alekseev, S.I. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1987. 16p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703133/JAW.

X-ray techniques for study of texture in graphite articles are developed. Construction of whole pole figures gives the picture of normal distribution of basis planes and permits to disclose directions in articles, where maximum anisotropy of properties is possible. The obtained data permit to determine coefficients of anisotropy of physical and mechanical properties, particularly, radiation growth and thermal expansion by means of existing analytical expressions. Examples of different texture specimens cut off graphite blocks produced according to various procedures are presented. Study of texture of spherical articles exhibited essential difference in coefficients of anisotropy in surface and deep layers of these articles, that may essentially affect variation of their dimensions under radiation. 7 refs.; 10 figs.

40432 **(IC—87/246) Pseudobinary glassy compositions (AsSe/sub x/)/sub 1-y/(AsTe/sub x/)/sub y/.** El Mously, M.K.; El Dem, M.B. (International Centre for Theoretical Physics, Trieste (Italy); Ain Shams Univ., Cairo (Egypt). Physics Dept.). (International Centre for Theoretical Physics, Trieste (Italy)). Sep 1987. 15p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702963/JAW.

The ternery glassy composition of the general formula (AsSe/sub x/)/sub 1-y/(AsTe/sub x/)/sub y/ can be considered as a pseudobinary system at x=1, 3/2 and 5/2 and $0 \leq y \leq 1$. The results of DTA, electrical conductivity measurements, density of such glasses as well as the X-ray diffraction of the crystallized samples have been used to confirm this point of view and to explain the presence of new phases not shown in the simple binary systems As-Se and As-Te. The possibility of transformation of the glassy network from partially polymerized state MCN (molecular cluster network) to completely polymerized state CRN (continuous random network) by mixing two structural units was also discussed. (author). 12 refs, 7 figs, 2 tabs.

40433 **(IC—87/405) Metallization and characterization of a silicon p-n junction diode fabricated from a solar-cell-type silicon substrate.** Ebong, A.U.; Adjepong, S.K. (International Centre for Theoretical Physics, Trieste (Italy)). Dec 1987. 7p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88703007/JAW.

The paper describes the metallization and characterization of a silicon p-n junction diode fabricated, in the laboratory, from a solar-cell-type silicon substrate, using simple equipment and locally-available materials. Metallization of the fabricated device was achieved by electroless nickel plating without the use of a chemical activator such as palladous chloride (PdCl/sub 4/) which is very expensive. On the basis of the abrupt-junction approximation, values for the substrate concentration and the built-in potential of the fabricated device are calculated from the latter C-V profile and found to be ~ 8.5x10/sup 15/cm/sup -3/ and 0.53V respectively. The value of the substrate concentration agrees fairly well with that estimated from the resistivity of the substrate. (author). 5 refs, 3 figs.

40434 **(JAERI-M—88-047) Studies on radiation resistance of fiber reinforced plastic composites featured by easiness of manufacturing, 2. Mechanical properties at low temperature and at room temperature.** Udagawa, Akira; Egusa, Sigenori; Sasuga, Tsuneo . (Japan Atomic Energy Research Inst., Tokyo). Mar 1988. 31p. (In Japanese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88754124/JAW.

Various mechanical properties were examined at room temperature and at 123 or 77 K on five kinds of glass fiber reinforced plastics (GFRP) irradiated with electron beams. Dynamic viscoelastic properties and fractography by means of scanning electron microscopy (SEM) were also measured in order to clarify degradation behavior. Considerable decrease in interlaminar shear strength (ILSS) at room temperature was observed above the absorbed dose of 60 MGy, while three-point bending strength showed no change even up to 100 MGy. On the other hand, the three-point bending strength and the ILSS at 123 K or 77 K strikingly decreased with increasing absorbed dose. The fractography reveals that debonding of glass fiber and matrix resin or the degradation of silane coupling agents plays an important role in the strength reduction at low temperature. These findings suggest that the interface between matrix and fiber loses its bondability at low temperature after electron beam irradiation, although high bond strength still remeins at room temperature.

40435 **(JAERI-M—88-071) Structure induced in polyimide by Kr/sup +/ irradiation.** Nakase, Yoshiaki. (Japan Atomic Energy Research Inst., Tokyo). Mar 1988. 24p. (In Japanese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88754132/JAW.

The effects of Kr/sup +/ irradiation on films of polyimide was investigated to evaluate the struoture changes and the Kr atom retention. The surface of the irradiated region showed metallic gray color and its electric conductivity was increased. X-ray diffraction and IR spectra showed no characteristic change. Analyses by such as X-ray photoelectron spectroscopy, Rutherford backscattering showed that Kr atoms existed at surface layer with the depth profile deeper, but broader than the theoretical estimation. Carbonization occurred due to the sputtering of N, O atoms, and several cracks were observed in the cross section micrograph of Kr/sup +/ irradiated films. Most of the implanted Kr atoms were retained in spherical regions with about 15 nm diameter.

40436 **(KU-HCOE-FL2-R—88-2) High pressure phases of uranium monophosphide studied by synchrotron X-ray diffraction.** Staun Olson, J.; Gerward, L.; Benedict, U.; Dabos, S.; Vogt, O. (Copenhagen Univ. (Denmark). H.C. Oersted Inst.; Commission of the European Communities, Karlsruhe (Germany, F.R.). European Inst. for Transuranium Elements; Eidgenoessische Technische Hochschule, Zurich (Switzerland). Lab. fuer Festkoerperphysik). 1988. 25p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88754030/JAW.

X-ray diffraction studies have been performed on UP powder for pressures up to 51 GPa using synchrotron radiation and a diamond anvil cell. At ambient pressure UP has the rocksalt structure. The bulk modulus has been determined to B/sub 0/ = 102(4) GPa and its pressure derivative to B/sub 0/' = 4.0(8). The cubic phase has been found to transform to a new phase, UP II, at about 10 GPa. UP II can be characterized by a rhombohedral Bravais lattice. UP II transforms to an orthorhombic phase, UP III, at 28 GPa. No volume change has been observed at the two transitions. The influence of the 5f electrons on the transformations is discussed.

40437 **(LBL—23655) Preparation of semiconductor cross sections by cleaving.** Hetherington, C.J.D. (Lawrence Berkeley Lab., CA (USA)). Feb 1988. Contract AC03-76SF00098. 13p. (CONF-871124—97). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88008250/JAW.

From Fall meeting of the Materials Research Society; Boston, MA, USA (30 Nov 1987).

The practical details are presented for preparing cross-sectional samples of semiconductor epitaxial layers by cleaving. Examples of results are shown and a number of possible applications for the samples are discussed. A variation of the method can be used to prepare a TEM sample of a high T/sub c/ superconductor. 11 refs., 6 figs.

40438 **(LBL—25242) Deep level defects in semiconductors: Stress and pressure studies.** Nolte, D.D. (Lawrence Berkeley Lab., CA (USA)). May 1988. Contract AC03-76SF00098. 195p. NTIS, PC A09/MF A01;1; GPO Dep. Order Number DE88010855/JAW.

Deep-level defects in semiconductors have strongly localized wavefunctions, which sample near-neighbor potentials around the defect center. These defects therefore can couple strongly to the local lattice, leading to many interesting phenomena, including large lattice relaxation. One method to probe the defect-lattice coupling is by applying stress or pressure. The application of stress or pressure to a semiconductor sample containing deep-level defects alters the lattice spacings around the defects and consequently alters their energy position in the bandgap. The magnitude of the energy shift under stress, as well as the dependence of the energy shift on uniaxial stress direction, can provide information concerning the structure of the deep level and its symmetry. Uniaxial stress applied in conjunction with deep level transient spectroscopy is a relatively new technique for probing the symmetry of deep-level defects. Uniaxial stress lowers the symmetry of the crystal and can break the degeneracy of defects, leading to energy splitting. The effect of these splittings on the thermal emission of carriers from defects is discussed in detail. The limit of energy resolution for this thermal ionization technique is also investigated.

40439 **(LBL—25244) State of the art of negative luminescence.** Berdahl, P.; Malyutenko, V.; Morimoto, T. (Lawrence Berkeley Lab., CA (USA); AN Ukrainskoj SSR, Kiev. Inst. of Semiconductors; Kyoto Univ., Uji (Japan). Inst. of Atomic Energy). Apr 1988. Contract AC03-76SF00098. 7p. (CONF-880870—1). NTIS, PC A02/MF A01;1; GPO Dep. Order Number DE88010871/JAW.

From 4. international conference on infrared physics; Zurich, Switzerland (22 Aug 1988).

In semiconductors, when the equilibrium carrier concentrations are reduced, either by carrier extraction 6 reversed-biased diode junctions, or by the magnetoconcentration effect, the normal equilibrium process of light emission due to carrier recombination is suppressed. Therefore, semiconductors exhibit negative luminescence. It is most readily observed when the energy gap, E/sub g/, of the semiconductor is not too large compared to kT; this condition assures that there is some overlap between the blackbody spectrum and the characteristic band-to-band emission spectrum of the semiconductor.

40440 **(PB—88-191606/XAB) Structures and mechanical characteristics of metallic-matrix composite materials prepared by a semi-solid method: case of the A1-Si/SiC system.** Suery, M. (Institut National Polytechnique, 38 - Grenoble (France)). Sep 1987. 64p. (In French). NTIS, PC E04/MF E04.

This report is a four-page summary, in French, of two papers written in English and attached as Appendix 1 and Appendix 2. Fabrication and properties of metal matrix composites based on SiC-fiber reinforced aluminum alloys by C. Milliere and M. Suery, to be published in Materials Science and Technology: Composites made of Al-7 wt% Si alloys and discontinuous Nicalon SiC-fibers were prepared by compocasting followed by squeeze casting. The technique gives rise to macroscopically homogeneous materials with some segregation of the fibers in the eutectic phase, especially for the lowest volume fractions. The SiC fibers appreciably improve wear resistance, hardness, and compressive strength of the matrix, both in the as-cast and heat-treated conditions. An analysis of the compressive test results is given, based on the mixture rule modified to apply to discontinuous randomly oriented fiber composites. Structure and mechanical properties of SiC-particle reinforced aluminum-alloy composites by M. A. Bayoumi and M. Suery (ICCM VI/ECCM2, London, July 1987): Metal-matrix composites containing 0-20 wt% of relatively small SiC particles (sizes ranging from 7 to 29 micrometers) were produced through compocasting. Metallographic examination shows that particle distribution is homogeneous for coarse particles, whereas some agglomeration occurs in the case of smaller particles. Tension and compression properties were evaluated at both room and elevated temperatures and correlations with volume fraction and particle size were established. The difference in the behavior of the composites in tension and compression is attributed to the presence of residual stresses in the particles and at the particle-matrix interface.

40441 **(PB—88-864301/XAB) Amorphous silicon thin films. July 1985-May 1988 (Citations from the Engineering Index data base). Report for July 1985-May 1988.** (National Technical Information Service, Springfield, VA (USA)). May 1988. 122p. NTIS PC N01/MF N01.

Supersedes PB—87-859849.

This bibliography contains citations concerning properties, substrate compatibility, testing, structure, and electronic applications of amorphous-silicon thin films. Methods for the deposition of silicon semiconducting films, such as sputtering, vapor deposition, and glow discharges are discussed. Optical and electrical properties relative to solar-cell applications, and the preparation of hydrogenated amorphous silicon thin films are considered. (This updated bibliography contains 262 citations, 68 of which are new entries to the previous edition.)

40442 **(PB—88-864780/XAB) Metal-matrix composites. January 1970-May 1988 (Citations from the US Patent data base). Report for January 1970-May 1988.** (National Technical Information Service, Springfield, VA (USA)). May 1988. 69p. NTIS PC N01/MF N01.

This bibliography contains citations of selected patents concerning fabrication methods, applications, and manufacturing equipment for metal-matrix composites. Various metal-matrix composites are examined, including aluminium, nickel, copper, titanium, boron-containing, and fiber-reinforced composite materials. Techniques for welding, rolling, coating, and heat treating of metal-matrix materials and components are discussed. Manufacturing methods in fabricating metal-matrix components for gas turbines, internal-combustion engines, nuclear reactors, x-ray detectors, aerospace vehicles, and semiconductor/superconductor devices are presented. (Contains 149 citations fully indexed and including a title list.)

40443 **(PB—88-864988/XAB) Silicon-carbide reinforced-aluminum composites. January 1972-May 1988 (Citations from the International Aerospace Abstracts data base). Report for January 1972-May 1988.** (National Technical Information Service, Springfield, VA (USA)). Jun 1988. 61p. NTIS PC N01/MF N01.

U.S. sales only.

This bibliography contains citations concerning the properties and fabrication of silicon carbide/aluminum composite materials. Fatigue behavior, reinforcement methods, dimensional stability, tensile properties, wear resistance, interface studies, pitting behavior, corrosion, and microstructure are among the properties discussed. Fabrication methods discussed include extrusion and hot rolling. (Contains 130 citations fully indexed and including a title list.)

40444 **(PB—88-865050/XAB) Polymer radiation curing: styrenes and vinyls. January 1970-May 1988 (Citations from the NTIS data base). Report for January 1970-May 1988.** (National Technical Information Service, Springfield, VA (USA)). Jun 1988. 119p. NTIS PC N01/MF N01.

Supersedes PB—87-857702.

This bibliography contains citations concerning the radiation-induced crosslinking of two polymeric resins: vinyls and styrenes. Processes for curing by gamma, ultraviolet, and infrared radiation are emphasized in this bibliography; however, techniques of polymer crosslinking by other forms of electromagnetic wave radiation such as microwave, laser, vacuum irradiation, and ionization are included. Effects of radiation-induced polymer crosslinking on such properties as thermal conductivity, viscoelasticity, corrosion resistance, compression strength, and hardness are also included. (This updated bibliography contains 228 citations, 21 of which are new entries to the previous edition.)

40445 **(SAND—87-2180) Washing and filtration study of the 1 kg batch-type chemical powder preparation process for high field varistor fabrication.** Lockwood, S.J.; Gardner, T.J. (Sandia National Labs., Albuquerque, NM (USA)). Jun 1988. Contract AC04-76DP00789. 30p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88013156/JAW.

The washing and filtration procedures for both the oxalate (Zn-Co-Mn-Al) coprecipitate and the Bi_2O_3-doped zincite powder are critical steps in the chemical preparation of high field varistor materials. Several alternate filtration schemes were evaluated in an effort to streamline the process, but all produced varistor material with unacceptable physical and/or electrical properties. Residual cation and anion levels were investigated as the possible explanation for the poor varistor properties. All filtration schemes were equivalent with respect to the final powder levels of Si^{4+}, Ba^{2+}, Ca^{2+}, Mg^{2+}, and Na^{+}. However, Cl/sup {minus}/ levels were found to vary by up to an order of magnitude depending on the washing technique employed. Cl/sup {minus}/ levels as low as 0.04 wt % caused electrical property degradation. Although none of the alternate filtration schemes evaluated were superior to the original procedure, these experiments resulted in process control improvements. 9 refs., 7 figs., 5 tabs.

40446 **(SAND—87-2588C) The effects of Hertzian stress and test ambient on the friction coefficient of MoS_2 coatings.** Pope, L.E.; Panitz, J.K.G. (Sandia National Labs., Albuquerque, NM (USA)). 1988. Contract AC04-76DP00789. 15p. (CONF-880488—1). NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88008118/JAW.

From 15. international conference on metallurgical coatings; San Diego, CA, USA (11 Apr 1988).

Rf sputter deposited MoS_2 coatings on 304 stainless steel substrates have been evaluated for different deposition and different storage conditions. For air testing, the friction coefficient of all of the MoS_2 coatings decreased with increasing Hertzian stress up to an intermediate stress and was constant for still higher stresses. A lower friction coefficient occurred for samples stored in the lower relative humidity ambient. The constant friction coefficient with increasing stress regime initiated at a lower Hertzian stress for 2% relative humidity storage. The MoS_2 films were predominantly crystalline; however, a small amount of amorphous material was present. The coatings with the larger amount of amorphous material had the larger friction coefficient. Testing in ultrahigh vacuum lowered the friction coefficient relative to testing in air for both relative humidities, but this testing did not recover all of the increase in friction coefficient for air testing that was attributed to high humidity storage. The coatings had all orientations, but the basal planes were predominantly perpendicular to the substrate surface. The sulfur to molybdenum ratio did not decrease significantly with high humidity storage, although the crystallographic orientation of the films were similar. Hence, these results indicate that factors in addition to orientation affect the oxidation of MoS_2 films. 23 refs., 1 fig., 1 tab.

40447 **(SAND—88-0105C) Boron carbides: Evidence for molecular level disorder.** Tallant, D.R.; Aselage, T.L.; Campbell, A.N.; Emin, D. (Sandia National Labs., Albuquerque, NM (USA)). 1988. Contract AC04-76DP00789. 7p. (CONF-880726—1). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88012389/JAW.

From 4. international conference on structure of non-crystalline materials; Oxnard, CA, USA (18 Jul 1988).

A Raman spectroscopic study confirms a structural model for boron carbides that was inferred from theory, transport data, and magnetic measurements. In this model substitutional disorder occurs within the icosahedra and chains that make up the boron carbide structure. 6 refs., 4 figs.

40448 **(SAND—88-1518C) Sol-gel kinetics: ^{29}SI NMR and a statistical reaction model.** Assink, R.A.; Kay, B.D. (Sandia National Labs., Albuquerque, NM (USA)). [1988]. Contract AC04-76DP00789. 6p. (CONF-8806138—1). NTIS, PC A02/MF A01;1; GPO Dep. Order Number DE88011545/JAW.

From BES/materials science program review; Albuquerque, NM, USA (27 Jun 1988).

Sol-gel processes allow one to prepare novel materials at low processing temperatures. A detailed understanding of the chemical kinetics of such systems is important to fully exploit the unique features of sol-gel processing. This paper describes a systematic approach to the study of sol-gel kinetics which employs ^{29}Si NMR spectroscopy and kinetic modelling techniques. 2 figs., 1 tab.

40449 **(UCRL—98725) Evaluation of a new failure criterion for fibrous composite materials.** Christensen, R.M.; Swanson, S.R. (Lawrence Livermore National Lab., CA (USA); Utah Univ., Salt Lake City (USA)). 4 May 1988. Contract W-7405-ENG-48. 17p. (CONF-8806107—2). NTIS, PC A03/MF A01; GPO Dep. Order Number DE88010713/JAW.

From American Society for Mechanical Engineers and Society of Engineering Sciences meeting; Berkeley, CA, USA (20 Jun 1988).

This paper presents a new failure criterion for fibrous composites. The failure theory is based on two separate criteria for fiber and matrix/interphase failure, which must be considered as separate events and described separately. The forms for these new criteria are suggested by a simplified three-dimensional lamination constitutive relationship developed previously. The failure criteria are compared with published experimental data, with encouraging results.

40450 **Electronic structure and stability of II—VI semiconductors and their alloys: The role of metal d bands.** Wei, S.; Zunger, A. (Solar Energy Research Institute, Golden, Colorado 80401). *Journal of Vacuum Science and Technology, A: Vacuum, Surfaces, and Films;* 6: No. 4, 2597-2611(Jul 1988).

It has been traditionally accepted in various theoretical approaches to II—VI semiconductors (e.g., tight binding, pseudopotentials) to neglect the effects of the cation d bands, hoping that in some sense they are "deep," "localized," and hence, unresponsive to many perturbations of chemical interest. There are, however, two qualitative reasons to think that this is not so: first, d bands in II—VI's are only 7—11 eV below the valence-band maximum (VBM) (i.e., inside the main valence band), and second, in tetrahedral (but not octahedral) symmetry, cation d orbitals have the same representation (Γ_{15}) as the anion p orbitals, hence the two can interact. We have considered the effects of the cation d bands in II—

VI's on both the electronic and structural properties of the binary and ternary compounds, treating all electrons on the same footing, in a self-consistent first-principles manner. We find that the d orbitals: (i) reverse the direction of charge transfer in the alloy (e.g., relative to s—p tight binding), (ii) reverse the trends in the spin—orbit splitting at the VBM in the series ZnTe→CdTe→HgTe, (iii) are responsible for most of the valence-band offset between, e.g., HgTe—CdTe, (iv) affect the structural stability, equilibrium lattice parameters, and bulk moduli.

40451 **The effective conductivity of a composite material with a periodic rectangular geometry.** Gautesen, A.K. (Ames Lab. and Dept. of Mathematics, Iowa State Univ., Ames, IA (US)). *SIAM Journal on Applied Mathemadics;* **48**: No. 2, 393-404(Apr 1988).

The authors consider a composite material which has a periodic rectangular geometry. After developing a method for solution, they give a simple but accurate formula for the effective conductivity, which is valid for all values of the physical parameters.

40452 **A study of postannealing and in situ annealing of silicon wafers implanted with a high dose of oxygen.** Wang, P.; Sjoreen, T.P.; Chang, L.; Demer, L.J. (Keramont Research Corp., Tucson, AR (US)). *Journal of the Electrochemical Society;* **135**: No. 1, 186-189(Jan 1988).

The effects of postannealing and in situ annealing on the reduction of oxygen ion implantation damage in silicon wafers were investigated by means of scanning electron microscopy, Rutherford backscattering spectrometry, and transmission electron microscopy. The results of this study, which utilized an etch-pit technique in conjunction with the SEM, showed that a high postannealing temperature (>1000°C) was needed to effectively lower the imperfection density in the top surface region of silicon wafers. A postannealing time of 2h at a high temperature (>1000°C) was sufficient to significantly reduce the implantation damage in the top silicon surface region. Finally, in situ annealing by wafer substrate heating during oxygen ion implantation was found to be more effective than postannealing at 1000°C. A 10 μm epitaxial layer containing a low density of dislocations (about 5 x 10/sup 6/ dislocations/cm/sup 2/) was able to be grown onto the in situ annealed wafers.

40453 **Neutron damage equivalence for silicon, silicon dioxide, and gallium arsenide.** Luera, T.F.; Kelly, J.G.; Stein, H.J.; Lazo, M.S.; Lee, C.E.; Dawson, L.R. (Sandia National Labs., P.O. Box 5800, Alb., NM (US)). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* **NS-34**: No. 6, 1557-1563(Dec 1987). (CONF-8707112—). Contract AC04-76DP00789.

From Annual conference on nuclear and space radiation effects; Snowmass Village, CO, USA (28 Jul 1987).

Displacement- and ionization-energy transfers to Si, SiO/sub 2/, and GaAs as functions of incident neutron energy were calculated using new cross section data and fine group structure in the NJOY code system. Neutron spectra determinations for several reactor neutron environments were made using new activation cross sections and a new technique with the SAND II code. Measurements of carrier removal rates in GaAs and of Si transistor gain degradation were made in representative neutron environments. Experimental results are compared to damage ratios predicted with the new spectra and NJOY displacement functions. For fission-like spectra, calculated Si damage ratios are in good agreement with those determined with ASTM E722-85 and with measured transistor damage ratios. Significant differences are found between Si NJOY and ASTM E722-85 for 14-MeV-to-reactor neutron damage ratios where NJOY gives better agreement with experimental data reported in the literature. In GaAs 14-MeV-to-reactor experimental damage ratios are smaller than predicted by calculated displacement ratios. This suggests that a more complex model of damage for majority carrier removal in GaAs is required. The use of incorrect damage functions is shown to adversely affect simulation fidelity in some representative neutron environments.

40454 **Transient measurements of ultrafast charge collection in semiconductor diodes.** Wagner, R.S.; Bradley, J.M.; Bordes, N.; Maggiore, C.J.; Sinha, D.N.; Hammond, R.B. (Electronics Research Group, Los Alamos National Lab., Los Alamos, NM (US)). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* **NS-34**: No. 6, 1240-1245(Dec 1987). (CONF-8707112—).

From Annual conference on nuclear and space radiation effects; Snowmass Village, CO, USA (28 Jul 1987).

Funneling-current transients produced in semiconductor devices are predicted to occur on a picosecond time scale. The authors measured these transients using a high bandwidth sampling system. Measurements were made on 1, 3, and 10 Ω-cm silicon low capacitance diode and 10/sup 16/ cm/sup -3/ Te-doped GaAs diodes. The data is compared to the Hsieh, Murley and O'Brien, the McLean and Oldham, and the Messenger models. Risetime versus doping density, peak current, total charge, and amplitude versus bias were measured. Also, current transients and prompt charge versus energy are presented.

40455 **Heavy-ion-induced, gate-rupture in power MOSFETs.** Fischer, T.A. (Sandia National Labs., Albuquerque, NM (US)). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* **NS-34**: No. 6, 1786-1791(Dec 1987). (CONF-8707112—).

From Annual conference on nuclear and space radiation effects; Snowmass Village, CO, USA (28 Jul 1987).

A new, heavy-ion-induced, burnout mechanism has been experimentally observed in power metal-oxide-semiconductor field-effect transistors (MOSFETs). This mechanism occurs when a heavy, charged particle passes through the gate oxide region of n- or p-channel devices having sufficient gate-to-source or gate-to-drain bias. The gate-rupture leads to significant permanent degradation of the device. A proposed failure mechanism is discussed and experimentally verified. In addition, the absolute immunity of p-channel devices to heavy-ion-induced, semiconductor burnout is demonstrated and discussed along with new, non-destructive, burnout testing methods.

40456 **A reevaluation of worst-case postirradiation response for hardened MOS transistors.** Fleetwood, D.M.; Dressendorfer, P.V.; Turpin, D.C. (Sandia National Labs., P.O. Box 5800, Albuquerque, NM (US)). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* **NS-34**: No. 6, 1178-1183(Dec 1987). (CONF-8707112—).

From Annual conference on nuclear and space radiation effects; Snowmass Village, CO, USA (28 Jul 1987).

The "worst-case" postirradiation response of Sandia hardened n-channel transistors following Co-60 exposure to total dose levels of system interest is demonstrated to occur for zero-volt bias during radiation, and positive bias during a subsequent anneal. This observation is explained in terms of oxide-trapped and interface-state charge buildup and anneal. Additional results are presented which suggest that, for future technologies with very thin gate oxides, worst-case device leakage during irradiation may well occur for zero-volt irradiations. These results highlight the importance of periodically reevaluating the response of MOS devices during and after irradiation to determine worst-case test conditions, particularly as technologies advance and gate insulators become thinner.

40457 **The role of hydrogen in radiation-induced defect formation in polysilicon gate MOS devices.** Schwank, J.R.; Fleetwood, D.M.; Winokur, P.S.; Dressendorfer, P.V.; Turpin, D.C.; Sanders, D.T. (Sandia National Labs., Albuquerque, NM (US)). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* **NS-34**: No. 6, 1152-1158(Dec 1987). (CONF-8707112—).

From Annual conference on nuclear and space radiation effects; Snowmass Village, CO, USA (28 Jul 1987).

The role of hydrogen in the generation of radiation-induced interface-trap and oxide-trapped charge in MOS polysilicon gate capacitors has been investigated. The concentration of radiation-induced interface-trap and oxide-trapped charge measured both immediately after irradiation and after postirradiation anneal increases if high temperature anneals are performed in hydrogen. The au-

thors analyzed these results in the context of several models of interface-trap and oxide-trapped charge formation. The mutual increase in the concentration of oxide-trapped charge and the early-time (1 msec to 10 sec) component of interface-trap charge with the amount of hydrogen used during processing suggests that the breaking of Si-H or Si-OH bonds may be responsible for much of the defect formation at or near the silicon/silicon dioxide interface.

40458 **A model describing hot-carrier and radiation effects in MOS transistors.** McBrayer, J.D.; Pastorek, R.A.; Jones, R.V.; Ochoa, A. Jr. (Sandia National Labs., Albuquerque, NM (US)). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* **NS-34**: No. 6, 1647-1651(Dec 1987). (CONF-8707112—).

From Annual conference on nuclear and space radiation effects; Snowmass Village, CO, USA (28 Jul 1987).

Data that describe the magnitude and type of damage created in MOS transistors by hot carrier and ionizing radiation environments is presented. The interaction of the effects of these types of damage is described by a qualitative model that divides the damage into two damage regions.

40459 **Radiation hard 1.0μm CMOS technology.** Lee, K.H.; Desko, J.C.; Kohler, R.A.; Lawrence, C.W.; Nagy, W.J.; Shimer, J.A.; Steenwyk, S.D.; Anderson, R.E.; Fu, J.S. (AT and T Bell Labs., 555 Union Blvd., Allentown, PA (US)). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* **NS-34**: No. 6, 1460-1463(Dec 1987). (CONF-8707112—).

From Annual conference on nuclear and space radiation effects; Snowmass Village, CO, USA (28 Jul 1987).

This paper describes radiation test results of a radiation hard CMOS technology with 1.0 μm minimum geometry features. The radiation goals of this technology are to ensure the MOS devices are functional after 10 Mrad total dose irradiation, are single event upset hardened to less than 1E-10 errors per bit-day, are transient upset immune to 1E9 rads/sec and are latch-up free.

40460 **Structure of polymeric $PbTiO_3$ gels.** Dey, S.K.; Budd, K.D.; Payne, D.A. (Dept. of Ceramic Engineering and Materials Research Lab., Univ. of Illinois, Urbana, IL (US)). *Journal of the American Ceramic Society;* **70**: No. 10, C-295-C-296(Oct 1987). Contract AC02-76ER01198.

The structural features of $PbTiO_3$ gels were found to be highly dependent on hydrolysis conditions. Gels formed from acid-catalyzed solutions were clear and rubbery, whereas base-catalyzed gels were translucent or cloudy with phase separation. Direct TEM observations determined that acid-catalyzed gels were fibrous in character and physically homogeneous, whereas base-catalyzed gels had a coarse texture. Analyses by EDX and SAD indicated that acidic gels were chemically homogeneous and microcrystalline, whereas basic gels were heterogeneous and amorphous.

40461 **Laser etching and evaporation of CaF_2 studied by mass spectrometry.** Estler, R.C.; Apel, E.C.; Nogar, N.S. (Chemical and Laser Sciences, MS G738, Los Alamos National Lab. (US)). pp 93-94 of Topical meeting on microphysics of surface beams and adsorbates (Summaries). Washington, DC; Optical Society of America (1987). (CONF-870224—).

From 2. topical meeting on microphysics of surfaces, beams and adsorbates; Santa Fe, NM, USA (16 Feb 1987).

In this work the authors describe the interaction of relatively high-fluence laser pulses (phi≧10Jcm²) with polished CaF_2 substrates. Both electron impact- and laser ionization-mass spectrometry have been used to probe the material spalled by the fundamental (1.06μ) and harmonic 355 nm and 266 nm) outputs from a Q-switched Nd:YAG laser. Primary ions produced in the source region of a quadrupole mass spectrometer were detected by turning off the electron impact ionizer, while survey electron impact mass spectra were typically acquired at an energy of 75 eV. A time-of-flight mass spectrometer was modified to permit optical access by both the etching and interrogation laser beams. This latter apparatus was used to measure velocity distributions, and to provide optical spectroscopic identification of the ion precursors.

40462 **Mass spectral identification of UV-laser photoablation products from polymers.** Estler, R.C.; Nogar, N.S. (Chemical and Laser Sciences Div., Los Alamos National Lab. (US)). pp 59-60 of Topical meeting on microphysics of surface beams and adsorbates (Summaries). Washington, DC; Optical Society of America (1987). (CONF-870224—).

From 2. topical meeting on microphysics of surfaces, beams and adsorbates; Santa Fe, NM, USA (16 Feb 1987).

Recently, much attention has been given to the laser photoablation of polymeric films because of applications to the etching processes involved in the microelectronics industry. For a number of compounds, including PMMA (polymethylmethacrylate), PET (poly (ethylene terephthalate)), polycarbonate, and polyimide, it has been observed that short wavelength (193 nm) laser ablation results in precise and clean etching, while long wavelength (≧248 nm) ablation can result in melting, charring and burning. It has been proposed that the differences cited above in the ablative photodecomposition (APD) are a manifestation of the variation of photochemical quantum yields with wavelength, or possibly with intensity. If the quantum yield(s) for various photolytic processes are in fact wavelength dependent, one would expect that dependence to be manifest as a change in the distribution of volatilized products. The authors report here the direct observation of such quantum yield variations via mass spectrometric studies of the photoablation products.

40463 **The role of F-centers in electron- and photon-stimulated desorption from alkali halides.** Loubriel, G.M.; Green, T.A.; Tolk, N.H.; Haglund, R.F. Jr. (Sandia National Labs., Albuquerque, NM 87185 (US)). pp 90-92 of Topical meeting on microphysics of surface beams and adsorbates (Summaries). Washington, DC; Optical Society of America (1987). (CONF-870224—). Contract AC04-76DP00789.

From 2. topical meeting on microphysics of surfaces, beams and adsorbates; Santa Fe, NM, USA (16 Feb 1987).

Measurements of the time history of ground state neutral lithium desorption from LiF pulsed irradiation have resulted in a new model for lithium desorption. The authors report measurements of the time dependence of electron-stimulated desorption (ESD) of neutral ground state Li (Li/sup o/) from a LiF (100) surface during electron beam irradiation. The new experimental result is that the emission of Li/sup o/ persists for at least seconds after the excitation pulse. By contrast, the neutral excited lithium (Li/sup */) desorption is extremely fast (less than one hundred nanoseconds). The contrasting time scales suggest that Li/sup */ and Li/sup o/ are produced by completely different mechanisms and led us to a reconsideration of the delay mechanism presented in the literature for metal atom desorption in the alkali halides. They find that the persistence of the Li/sup o/ emission after a pulse can be explained in terms of the slow diffusion of bulk F (Farben) centers (an electron trapped in a halogen vacancy) created by the electron beam. A quantitative model which describes the bulk diffusion of the F centers and their surface conversion to a desorbed Li atom is used to extract from the data F center diffusion hopping rate and activation energy, as well as an F center surface residence time. The authors' results contrast with the generally accepted notion that the thermal desorption of the metal atom from the surface is responsible for the delays. While surface effects are also important, especially at very low temperatures, the data show that at high temperatures the delay in the metal atom signal is entirely due to the F center diffusion time.

40464 **Sum frequency generation on dye-coated surfaces using collinear and non-collinear excitation geometries.** Muenchausen, R.E.; Nguyen, D.C.; Keller, R.A.; Nogar, N.S. (Chemistry and Laser Sciences Div., Los Alamos National Lab. (US)). pp 63-65 of Topical meeting on microphysics of surface beams and adsorbates (Summaries). Washington, DC; Optical Society of America (1987). (CONF-870224—).

From 2. topical meeting on microphysics of surfaces, beams and adsorbates; Santa Fe, NM, USA (16 Feb 1987).

Second harmonic generation (SHG with a collinear excitation geometry is becoming an important tool for surface studies. Phase-matching on the surface in inherently satisfied since the nonlinear generation occurs over distances corresponding to only a few

monolayers. The authors report resonantly enhanced sum frequency generation (SFG) for both collinear and non-collinear excitation geometries.

40465 **Free carrier nonlinear optics.** Wolff, P.A. Cambridge, MA; Massachusetts Institute of Technology (1987). vp.

Free carriers in semiconductors cause optical nonlinearity in two ways. In some cases it arises from the inherent nonlinearity of electron dynamics in crystals; in others it is caused by scattering. Until lately, all known free-carrier-induced optical nonlinearities were weak. Two crystals, HgTe and HgCdSe:Fe, in which large, fast, free-carrier-induced chi (sup 3) may be attainable, were investigated. These materials will be used as examples to illustrate the mechanisms and features of free-carrier-induced optical nonlinearity. The nonlinear susceptibilities were measured by four wave mixing experiments performed with a pair of Q-switched CO_2 lasers. The absence of saturation is striking. The optical nonlinearity was attributed to the interband population modulation between the heavy mass valence band and the light mass conduction band. This presentation is represented by viewgraphs only.

40466 **High density femtosecond excitation of nonthermal carrier distributions in intrinsic and modulation doped GaAs quantum wells.** Knox, W.H.; Chemla, D.S.; Livescu, G. Holmdel, NJ; Bell Telephone Labs., Inc. (1987). vp.

The dynamics of nonthermal carrier distributions is studied in undoped and modulation doped GaAs Quantum Well Structures (layer thickness is approximately 100 A) with near bandgap-resonant intense femtosecond light pulses. The carrier-carrier scattering process was studied up to very high energies, and the first optical investigation of nonthermal carrier generation in the presence of a thermalized Fermi-sea of electrons was performed. In undoped quantum wells a reduction of the thermalization time was found from about 100 fs to about 30 fs as the photocarrier density increases from N sub eh is approximately 3 x 10 to the 10th/sq cm to approximately 10 to the 12th/sq cm. The thermalization time is found to be sensitive to background doping with excess electrons in modulation doped samples.

40467 **Experimental and theoretical studies of coherent and nonthermal processes in semiconductors probed by femtosecond laser techniques.** Peyghambarian, N.; Koch, S.W. Tucson, AZ; Arizona University (1987). vp.

The coherent interaction of femtosecond laser pulses and a thin CdSe sample is investigated both experimentally and theoretically. Observation of coherent phenomena in semiconductors is very rare because the incoherent processes occur in the femtosecond time domain in these materials. One example of such a phenomena is the so called optical Stark effect of exciton where a blue shift of the exciton resonance occurs as a result of pumping below the bandgap. The coherent effects involving band-to-band and also exciton transitions. Using femtosecond transmission measurements clear evidence was observed for coherent interference effects of the light field and the driven material polarization. These interferences manifest themselves as oscillatory structures in the differential transmission spectra. The oscillatory features are explained by comparison with a semiclassical theory. Examples of the computed results are presented for different time delays between probe and pump. To analyze the situation where the transmission spectra are measured in the vicinity of the exciton, the exciton is a single homogeneously broadened transition.

40468 **Femtosecond studies in hot carrier relaxation in GaAs and AlGaAs.** Ippen, E.P.; Fujimoto, J.G. Cambridge, MA; Massachusetts Institute of Technology (1987). vp.

Femtosecond carrier dynamics in GaAs and AlGaAs thin films were studied by femtosecond pump-probe absorption saturation spectroscopy. Identical pulse measurements monitor the rapid scattering of the carriers out of their initial, optically excited states. Multi-wavelength continuum probe investigations confirm the presence of the initial nonthermal carrier distribution as well as the appearance of state-filling throughout the band on a timescale of tens of femtoseconds. This presentation is represented by viewgraphs.

40469 **Hypervelocity impact of mixtures.** Drumheller, D.S. (Thermomechanical and Physical Div., Sandia National Labs., Albuquerque, NM (US)). pp 261-268 of Hypervelocity impact. Anderson, C.E. Elmsford, NY; Pergamon Books Inc. (1987). (CONF-861091—).

From Hypervelocity impact symposium; San Antonio, TX, USA (21 Oct 1986).

The study of the behavior of mixtures during shock loading entails several special problems which are both physical and computational in nature. On the physical level, many mixtures of interest such as engineering composites and water-saturated geological materials have constituents which are both soft and porous. Thus hypervelocity impact produces enormous heating. The distribution of this heating between the constituents of the mixture must be understood before accurate predictions of Hugoniot states and release paths can be achieved. On the computational level, numerical solutions within a wavecode framework require simultaneous solutions of an equation of state and conservation of energy equation for each constituent of the mixture. At present, to achieve these solutions a numerical subcycling scheme is required. In this paper these problems are discussed in detail. A formulation of the theory of mixtures is presented which is both complex enough to encompass the essential physics of many problems and simple enough to be incorporated into many wave propagation codes. Results of calculations are compared to impact and release experiments on a mixture of water and powdered calcite.

40470 **Laser diagnostics of silicon chemical vapor deposition: In situ measurements and comparisons with model predictions.** Breiland, W.G.; Ho, P.; Coltrin, M.E. (Sandia National Labs., Albuquerque, NM (US)). pp 912 of Proceedings of the tenth international conference on chemical vapor deposition, 1987. Cullen, G.W. Pennington, NJ; The Electrochemical Society (1987). (CONF-8710183—).

From 10. international conference on chemical vapor deposition; Honolulu, HI, USA (1 Oct 1987).

In situ measurements of gas temperature profiles and chemical species density profiles have been measured during the chemical vapor deposition (CVD) of silicon from silane. Laser Raman spectroscopy was used to obtain gas temperature profiles and silane density profiles, and laser-excited fluorescence was used to obtain relative density profiles of Si atoms and silicon dimers. These measurements are compared to profiles predicted by the mathematical model of Coltrin, Kee, and Miller. The authors give an overview of the gas-phase chemistry of this CVD process that results from the model predictions and experimental confirmations.

40471 **Carbon corrosion in low-temperature electrochemical systems.** Kinoshita, K. Houston, TX; National Assoc. of Corrosion Engineers (1987). 19p. (CONF-870314—). National Assoc. of Corrosion Engineers, P.O. Box 218340, Houston, TX 77218.

From Corrosion '87; San Francisco, CA, USA (9 Mar 1987).

The objectives of this paper are to analyze the corrosion of carbon in low-temperature (i.e., $< \leqq 200°C$) electrochemical systems, such as batteries, fuel cells, and electrolysis cells. Experimental measurements indicate that the corrosion rate of carbonaceous materials in aqueous electrolytes is a strong function of surface morphology; highly graphitized carbons have a lower specific corrosion rate than that of amorphous carbon. The effects of crystallographic parameter and electrolyte environment on the rate and mechanism of carbon corrosion, and solutions to overcome the corrosion problem in low-temperature electrochemical systems, are discussed.

40472 **Electronic properties of quantum wells in perturbing fields.** Collins, R.T.; Vina, L.; Wang, W.I.; Maihiot, C.; Smith, D.L. (IBM T.J. Watson Research Center, P.O. Box 218, Yorktown Heights, NY (US)). pp 2-9 of Quantum well and superlattice physics. Dohler, G.H.; Schulman, J.N. Bellingham, WA; SPIE Society of Photo-Optical Instrumentation Engineers (1987). (CONF-8703197—).

From Quantum well and superlattice physics; Bay Point, FL, USA (23 Mar 1987).

Studies of the response of excitonic transitions in quantum wells to external perturbations have proven useful in understanding

the electronic properties of quantum wells. This paper discusses the use of two such perturbations, electric fields and uniaxial stress, in photocurrent and photoluminescence excitation spectroscopy measurements on GaAs/Al/sub x/Ga/sub 1-x/As quantum wells. When an electric field is present in a square quantum well, forbidden excitonic transitions become visible. The excitons also exhibit a Stark shift to lower energies. Since the Stark shifts for different excitons are not the same, it is possible to tune the energy separations between the excitons. By applying electric fields to a 160 A well, an anticrossing between the excited states of the first heavy hole exciton and the 1s ground state of the first light hole exciton has been observed. The effect of a uniaxial stress on a quantum well is found to depend strongly upon the axis along which the stress is applied. This is in contrast to bulk GaAs. The application of a uniaxial stress to a quantum well can help determine the valence band symmetry of a particular exciton, since heavy and light hole excitons exhibit different energy shifts in a stress. This fact has been used in conjunction with polarization and electric field dependent measurements to identify exciton peaks which arise from mixing between the second heavy and first light hole valence subbands.

40473 **Free-carrier absorption and saturation of intervalence-band transitions in p-type semiconductor quantum wells.** Chang, Y.C.; James, R.B. (Dept. of Pls Research Lab., Univ. of Illinois at Urbana, Green Street, Urbana, IL (US)). pp 214-221 of Quantum well and superlattice physics. Dohler, G.H.; Schulman, J.N. Bellingham, WA; SPIE Society of Photo-Optical Instrumentation Engineers (1987). (CONF-8703197—).

From Quantum well and superlattice physics; Bay Point, FL, USA (23 Mar 1987).

Calculations of free-carrier absorption in p-type semiconductor quantum wells as a function of carrier density, temperature and light intensity are reported. Valence band dispersions used in the calculation are obtained by a multi-band effective mass method which includes the effects of warping and heavy-light hole mixing. Carrier lifetimes are taken into account within the deformation potential approximation. Deviation of hole distribution from thermal equilibrium due to optical pumping is included in the calculation, and the saturation behavior is studied.

40474 **Reduction of photoluminescence intensity with magnetic field in InGaAs/GaAs single strained layer quantum wells.** Smith, M.C.; Jones, E.D.; Schirber, J.E.; Drummond, T.J.; Heiman, D.; Foner, S. (Sandia National Labs., P.O. Box 5800, Albuquerque, NM (US)). pp 123-126 of Quantum well and superlattice physics. Dohler, G.H.; Schulman, J.N. Bellingham, WA; SPIE Society of Photo-Optical Instrumentation Engineers (1987). (CONF-8703197—).

From Quantum well and superlattice physics; Bay Point, FL, USA (23 Mar 1987).

The photoluminescence intensity of InGaAs/GaAs strained layer single quantum wells with p-type doping was measured as a function of magnetic field. Two different experimental techniques were used, and both show a reduction of intensity with complete suppression occurring at B=35T. Self-consistent potential and energy level calculations indicate complete migration of charge of the well back to the dopants as a consequence of applied magnetic field.

40475 **Bandgap energy pressure coefficients in strained-layer structures.** Jones, E.D.; Fritz, I.J.; Hjalmarson, H.P.; Schirber, J.E.; Smith, M.C.; Biefeld, R.M.; Dawson, L.R.; Drummond, T.J. (Sandia National Labs., Albuquerque, NM (US)). pp 117-122 of Quantum well and superlattice physics. Dohler, G.H.; Schulman, J.N. Bellingham, WA; SPIE Society of Photo-Optical Instrumentation Engineers (1987). (CONF-8703197—).

From Quantum well and superlattice physics; Bay Point, FL, USA (23 Mar 1987).

The hydrostatic-pressure coefficients of the bandgap energies for four different types of semiconductor heterojunction structures were obtained from photoluminescence measurements at 4K and pressures up to 4 kbar. The structures studied were n-type and p-type In/sub x/Ga/sub 1-x/As/GaAs and n-type GaAs/GaP/sub x/As/sub 1-x/ strained-layer superlattices, n-type In/sub x/Ga/sub 1-x/As/GaAs single strained quantum wells and an undoped GaAs/AlAs superlattice. The bandgap energies ranged from 1800 meV for the GaAs/AlAs structure to 1280 meV for the In/sub x/Ga/sub 1-x/As/GaAs single strained quantum wells. Pressure coefficients for the In/sub x/Ga/sub 1-x/As/GaAs and GaAs/GaP/sub x/As/sub 1-x/ structures were found to be in the range of 10 to 12 meV/kbar. However, the pressure coefficient of the luminescence energy from the GaAs/AlAs superlattice was found to be -2 meV/kbar. This negative pressure coefficient is consistent with the interpretation that the luminescence is due to a transition between the conduction-band X-point in the AlAs layers and the valence-band Γ-point in the GaAs layers.

40476 **X-ray-diffraction characterization of CdTe epitaxial layers on GaAs substrates as a function of temperature.** Horning, R.D. Ames, IA; Iowa State Univ. (1986). 184p. University Microfilms Order No. 87-03,713.

Thesis (Ph. D.).

X-ray-diffraction methods were used to study the structural and thermal properties of CdTe epitaxial layers on GaAs substrates. The technique of precession photography is introduced as an extremely useful method for qualitative characterization of thin films, and reveals twin faults in (1,1,1) oriented CdTe epilayers. Measurements of the Bragg reflections as a function of temperature were made between 10 and 360 K. These measurement reveal anomalous behavior in the lattice parameters of both the substrate and the epilayer in a (0,0,1) oriented sample deposited at 410°C. The overall change in the CdTe lattice parameter in this temperature range was about five times larger than in bulk CdTe, and the change in the substrate lattice parameter was about three times the bulk value. These anomalies were absent in a similar sample deposited at 380°C. Similar measurements were made on GaAs and CdTe single crystals for comparison. The Debye temperatures extracted from the integrated intensities of the reflections perpendicular to the surface are ~ 250 K for the GaAs substrates and ~ 142 K for the CdTe epilayers. These are the same as the corresponding values in single crystals of GaAs and CdTe, revealing no significant change in the overall vibrational properties. The Debye temperatures extracted form reflections not perpendicular to the surface are significantly lower.

40477 **Second order optical effects in multilayer polymeric thin films.** Kowel, S.T.; Hayden, L.M.; Selfridge, R.H. (Electrical and Computer Engineering, Univ. of California, Davis, CA (US)). pp 103-108 of Molecular and polymeric optoelectronic materials: Fundamentals and applications. Khanarian, G. Bellingham, WA; SPIE Society of Photo-Optical Instrumentation Engineers (1986). (CONF-860880—).

From 30. SPIE technical symposium on optics and optoelectronic engineering; San Diego, CA, USA (17 Aug 1986).

Multilayer Langmuir/Blodgett thin films provide a means of designing thin film optical devices monolayer by monolayer. A single layer of a hemicyanine dye or a mixture of hemicyanine dye and PMMA, as the polymeric host, produce second harmonic generation (SHG). With proper dipping procedure it is possible to deposit such films one monolayer at a time and maintain the noncentrosymmetric structure required for SHG. Addition of more layers of the same material increases the amount of generated second harmonic. This evidence of enhanced second harmonic generation in multilayer Langmuir/Blodgett thin films will be presented. Discussion of microwave detection using the linear electrooptic effect in slab and coated fiber structures will be presented. Some of the theoretical problems and advantages of using optical fibers coated by Langmuir/Blodgett films are discussed. Emphasis is placed on the importance of developing in situ diagnostic tools for use during deposition of the organic films.

40 CHEMISTRY

40478 **(ANL—88-19) Chemical technology division: Annual technical report 1987.** (Argonne National Lab., IL (USA)). May 1988. Contract W-31109-ENG-38. 208p. NTIS, PC A10/MF A01;1; GPO Dep. Order Number DE88011588/JAW.

Highlights of the Chemical Technology (CMT) Division's activities during 1987 are presented. In this period, CMT conducted

research and development in the following areas: (1) high-performance batteries--mainly lithium-alloy/metal sulfide and sodium/sulfur; (2) aqueous batteries (lead-acid, nickel/iron, etc.); (3) advanced fuel cells with molten carbonate or solid oxide electrolytes; (4) coal utilization, including the heat and seed recovery technology for coal-fired magnetohydrodynamics plants and the technology for fluidized-bed combustion; (5) methods for the electromagnetic continuous casting of steel sheet and for the purification of ferrous scrap; (6) methods for recovery of energy from municipal waste and techniques for treatment of hazardous organic waste; (7) nuclear technology related to a process for separating and recovering transuranic elements from nuclear waste, the recovery processes for discharged fuel and the uranium blanket in a sodium-cooled fast reactor, and waste management; and (8) physical chemistry of selected materials in environments simulating those of fission and fusion energy systems. The Division also has a program in basic chemistry research in the areas of fluid catalysis for converting small molecules to desired products; materials chemistry for liquids and vapors at high temperatures; interfacial processes of importance to corrosion science, high-temperature superconductivity, and catalysis; the thermochemistry of various minerals; and the geochemical processes responsible for trace-element migration within the earth's crust. The Division continued to be the major user of the technical support provided by the Analytical Chemistry Laboratory at ANL. 54 figs., 9 tabs.

4001 Analytical And Separations Chemistry

REFER ALSO TO CITATION(S) 39062, 39193, 39262, 39430, 39465, 39468, 39469, 39657, 40306, 40427, 40427, 40452, 40461, 40462, 40464, 40472, 40520, 40524, 40524, 40557, 40694, 41251, 41731

40479 (AD-A—191925/7/XAB) Characterization of yttrium aluminum garnet/YAG/using 14-meV neutron activation. Burns, F.; Chen, M.F.; Caslavsky, J.L. (Army Materials Research Agency, Watertown, MA (USA). Materials Technology Lab.). Dec 1987. 21p. NTIS, PC A03/MF A01.

A nondestructive method for the analysis of yttrium, aluminum and oxygen in yttrium aluminum garnet /YAG/ by 14-MeV neutron-activation analysis wad developed and evaluated. The fast neutron induces primarily /n,2n/, /n,p/, or /n, alpha/ reactions with yttrium, aluminum, and oxygen to produce isotopes with measurable characteristic gamma-ray spectra. Concentrations of Y, Al and O were determined on the basis of calibrated nuclear decay emission spectra recorded on selected standards. After each analysis the crystal was returned to the furnace for further adjustments of the growth parameters, and any resultant elemental variations were observed in the next analysis. The accuracy of this method was determined by repeated analyses with various YAG crystals from a series of separate furnace runs.

40480 (AD-B—064819/6/XAB) Atomic absorption analytical procedures. Interim technical report, 1 June 1980-28 February 1981. Rhine, W.E.; Saba, C.S.; Kauffman, R.E. (Dayton Univ., OH (USA). Research Inst.). Apr 1982. 136p. NTIS, PC A07/MF A01.

Distribution limitation now removed.

An investigation was conducted in order to determine and recommend optimum atomic absorption procedures for the analyses of wear metals in lubricating oils. The investigation involved determining the optimum sample-preparation procedures and optimum nitrous oxide-acetylene flame conditions that will provide wear-metal determinations of the desired accuracy and precision. Also included in this report is a summary of the research conducted to develop an analytical procedure that will quantitatively recover wear-metal particles regardless of their size. The method presented herein involves adding an acid mixture to the lubricant that dissolves the metallic particles present.

40481 (AERE-R—12742) Literature survey of techniques for the analytical determination of technetium-99. Long, S.E.; Sparkes, S.T. (UKAEA Harwell Lab. Environmental and Medical Science Div.; Department of the Environment, London (UK)). Jan 1988. 33p. (DOE-RW—87.123). H.M. Stationery Office, London, price Pound 5.00.

This report summarises a literature survey of analytical techniques for the measurement of technetium with emphasis on technetium-99. The merits and limitations of each are discussed, particularly with regard to sensitivity, interferences and applicability to various sample types. The chemistry and sources of technetium are also discussed.

40482 (BDX—613-3932) Development of improved analytical procedures for boron purification: Final report. Larson, J.D.; Fossey, J.L.; Hinds, S.C.; Lantz, L.L.; Smith, R.E. (Allied-Signal Aerospace Co., Kansas City, MO (USA). Kansas City Div.). Jun 1988. Contract AC04-76DP00613. 25p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88012403/JAW.

Three new analytical methods for boron powder certification were developed and evaluated during this project. First, the boric acid content of the powder was determined by an acid-base titration method. Second, the moisture content of boron samples was measured with a moisture evolution analyzer. Third, boron powder samples were acid digested in a microwave oven. 11 refs., 1 fig., 8 tabs.

40483 (BDX—613-3948) High temperature gel permeation chromatography of TPX, poly(4-methyl-1-pentene): Topical report. Fuller, E.N. (Allied-Signal Aerospace Co., Kansas City, MO (USA). Kansas City Div.). Jun 1988. Contract AC04-76DP00613. 25p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88013226/JAW.

High temperature gel permeation chromatography (GPC) methods for molecular weight characterization of isotactic poly(4-methyl-1-pentene), known commercially as TPX, have been developed. The effects of exposure to high analysis temperature and of sample concentration on the molecular weight values determined by GPC were investigated. 8 refs., 12 figs.

40484 (CEA-CONF—9326) Air ICP uses for instantaneous monitoring of airborne pollutants. Thouzeau, F.; Birolleau, J.C.; Fieni, J.M.; Bergey, C. (CEA Centre d'Etudes de Bruyeres-le-Chatel, 91 (France)). 1987. 13p. (CONF-870954—). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88753933/JAW.

From EUROANALYSIS VI: European conference on analytical chemistry; Paris, France (7 Sep 1987).

Recently the development of a pure AIR-ICP which breathes in and excites the analysed air without sample dilution, allowed the application of this technique to the real time analysis of airborne metallic pollutants. First results obtained on airborne Beryllium in a laboratory and a test-site apparatus are presented in this paper.

40485 (CEA-CONF—9327) Automatic collection of the rare-earths with post chromatography column detection. David, P.; Metzger, G.; Repellin, M. (CEA Centre d'Etudes de Bruyeres-le-Chatel, 91 (France)). 1987. 3p. (CONF-870954—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88753934/JAW.

From EUROANALYSIS VI: European conference on analytical chemistry; Paris, France (7 Sep 1987).

The complete separation of rare-earths (in the aim of radioisotopes measurement) requires High Performance Liquid Chromatography with ternary elution gradient. To automatize their collection with satisfying conditions, we have realized a non polluting, reliable and easy to operate detection method. This one is based on a derivation colorimetric system with arsenazo I (3 -(2 arsophenylazo 4.5) - dihydroxy - 2.7 naphtalene disulfonic acid).

40486 (CNEA—481) Empirical method for matrix effects correction in liquid samples. Quantitative determination of chromium, nickel and molybdenum in steels by x-ray fluorescence. Vigoda de Leyt, Dora; Vazquez, Cristina. (Comision Nacional de Energia Atomica, Buenos Aires (Argentina). Dept. de Quimica). (Comision Nacional de Energia Atomica, Buenos Aires (Argentina)). 1987. 19p. (In Spanish). NTIS (US Sales Only), PC A03/MF A01 - Comision Nacional de Energia Atomica, Buenos Aires (AR). Order Number DE88703113/JAW.

Informe.

A simple method for the determination of Cr, Ni and Mo in stainless steels is presented. In order to minimize the matrix effects, the conditions of liquid system to dissolve stainless steels chips has been developed. Pure element solutions were used as standards. Preparation of synthetic solutions with all the elements of steel and also mathematic corrections are avoided. It results in a simple chemical operation which simplifies the method of analysis. The variance analysis of the results obtained with steel samples show that the three elements may be determined from the comparison with the analytical curves obtained with the pure elements if the same parameters in the calibration curves are used. The accuracy and the precision were checked against other techniques using the British Chemical Standards of the Bureau of Anlysed Samples Ltd. (England). (M.E.L.).

40487 (CONF-870430—16) Determination of oxygen in alkali halide salts by proton activation and radiochemical separation. Wai, C.M.; Dysart, M.E.; Blander, M.; Heinrich, R.R.; Oselka, M.C. (Idaho Univ., Moscow (USA). Dept. of Chemistry; Argonne National Lab., IL (USA)). 1987. Contract W-31109-ENG-38. 15p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88010060/JAW.

From International conference on methods and applications of radioanalytical chemistry; Kona, HI, USA (5 Apr 1987).

A lanthanum fluoride precipitation method for the separation of ^{18}F produced from the $^{18}O(p,n)^{18}F$ reaction in alkali halide salts is described. This radiochemical separation method minimizes interferences from other positron emitters produced by proton bombardment and makes the accurate determination of ppM-level ^{18}O in complex alkali halide systems feasible. The interference from the $^{19}F(p,d)^{18}F$ reaction is eliminated by keeping the proton energy less than 8.2 MeV. Applications of this technique to studies of dissolved oxide species in molten alkali halide salts are discussed. 15 refs., 3 figs., 2 tabs.

40488 (CONF-870763—4) A data base for establishment of preanalytical holding times. Maskarinec, M.P.; Goodin, J.E.; Moody, R.L. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 14p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88011402/JAW.

From 3. annual solid waste testing and quality assurance symposium; Washington, DC, USA (14 Jul 1987).

Experiments aimed at precisely determining the preanalytical holding time for soil and water samples containing volatile organic compounds have been conducted. Three water samples, distilled water, surface water, and groundwater, as well as three soil samples, were fortified with a wide range of volatile organics. Aliquots of these samples were stored at three conditions for up to one year. Four replicates were analyzed by GC/MS at logarithmic time intervals. Objectives were to develop procedures for the preparation of the samples, to establish the holding time for each compound under each storage condition, and to develop or apply preservation techniques for the extension of the holding time. Most of the volatile organic compounds are stable for at least eight weeks, and probably beyond. Those which are not stable either undergo dehydrohalogenation (tetrachloroethane to trichloroethylene) or bacterial degradation (aromatics). This can be reduced or eliminated by the use of HCl as a preservative. Data on the stability of preserved samples will be presented. Results on the stability of volatiles in soil will also be reported. 10 tabs.

40489 (DOE/ER/13435—3) Fundamental studies with a monodisperse aerosol-based liquid chromatography/mass spectrometry interface (MAGIC-LC/MS): Progress report, September 1, 1985-SEPTEMBER 15, 1988. Browner, R.F. (Georgia Inst. of Tech., Atlanta (USA). School of Chemistry). May 1988. Contract FG05-85ER13435. 9p. NTIS, PC A02/MF A01;1; GPO Dep. Order Number DE88011628/JAW.

Technical advances have been made through a number of careful and detailed studies of fundamental processes occurring within the interface. These have led to great improvements in the performance of the interface, many of which are detailed below. Of particular importance has been an improvement in detection capabilities, allowing full-scan (40–400 daltons) electron impact mass spectra to be obtained with only approximately 5 ng of material injected on column. Selected ion monitoring gives detection limits in the range of 100 pg. These figures are particularly noteworthy because they represent values within a factor of 3 of the lowest detection limits possible with the same instrument when used in a GC/MS mode. The full range of compound types accessible with the MAGIC-LC/MS interface has not been fully investigated. In general terms, all compounds which are known to be capable of generating EI and CI spectra and which have been tried with the interface have generated good quality spectra. These include carbamate and triazine pesticides, phenyl urea herbicides, polynuclear aromatic hydrocarbons, plant alkaloids, antioxidants and EPA Appendix 8 compounds. Compounds known not to generate EI spectra, such as simple sugars and certain azo dyes, predictably do not generate spectra with the current system. The primary mode of ion formation appears to be through a flash vaporization step in the ion source, followed by EI or CI ionization, as selected. It is possible to generate good searchable EI spectra with strong molecular ions even for quite involatile species. An example is provided by reserpine, with a molecular weight of 608 daltons, which generates a searchable EI spectrum with a strong molecular ion at m/z 608. 11 refs.

40490 (DOE/ER/13613—12) Capillary liquid chromatography using laser-based and mass spectrometric detection: Technical progress report for the period September 1, 1987-SEPTEMBER 15, 1988. Sepaniak, M.J.; Cook, K.D. (Tennessee Univ., Knoxville (USA). Dept. of Chemistry). 1988. Contract FG05-86ER13613. 14p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88011183/JAW.

The focus of this work is the development of capillary liquid chromatography, in particular an electrokinetic separation technique that we have termed micellar electrokinetic capillary chromatography (MECC), as a practical separation technique for the analyses of volume-limited complex samples and for difficult-to-resolve compounds. Most of our research during this period has involved fundamental and practical studies of the MECC technique. Solutes are separated in MECC in open capillary columns based upon their differential distribution between an electroosmotically-pumped mobile phase and an electrophoretically-retarded micellar phase. In our work the electrophoretic flow of the micelles opposes and is of a smaller magnitude than the electroosmotic flow: Consequently, solutes that partition between the mobile and micellar phases are eluted within a limited retention range. The main virtues of the MECC technique are exceptional efficiency and the fact that it can be used to separate samples containing charged, neutral, or mixtures of charged and neutral solutes. The restriction of solutes demonstrating at least moderate water solubility and the limited elution range of the technique are limitations of MECC. 13 refs.

40491 (DOE-RW—87.116) Development of a laser-induced photoacoustic facility for actinide speciation. Ewart, F.T.; McMillan, J.W.; Pollard, P.M.; Thomason, H.P.; Liezers, M. (UKAEA Harwell Lab. Chemistry Div.; Manchester Univ. (UK). Inst. of Science and Technology). (Department of the Environment, London (UK); UKAEA Harwell Lab. Chemistry Div.). Sep 1987. 53p. (AERE-R—12875). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88754141/JAW.

A laser induced photoacoustic spectroscopy (LIPAS) facility has been developed at Harwell to measure actinide species in solution with the minimal disturbance of the species equilibria. The novel true dual beam system, which is based on an excimer laser driven dye laser and optical cells mounted on piezoelectric detectors, has high sensitivity and stability, and is capable of detecting Am(III) at ca 10/sup -8/M and Np(IV), (V) and (VI) at ca 10/sup -7/M. Samples can be measured in an inert atmosphere glove box which helps to maintain the anaerobic conditions expected in deep waste repositories. To date, LIPAS has been used to measure actinide species directly in solutions from waste programmes and to observe americium and neptunium species in solutions of varying Eh, pH and carbonate concentration. The information gained is being used to validate the data used in the geochemical/thermodynamic codes used to predict possible radionuclide species within a radioactive waste repository.

40492 **(GKSS—87/E/54) Radiometric dating and quantitative analysis of elements in depth profiles of sediments by means of nuclear physical as well as X-ray fluorescence and atomic emission spectroscopic methods.** Schoenburg, M. (GKSS-Forschungszentrum Geesthacht G.m.b.H., Geesthacht-Tesperhude (Germany, F.R.); Hamburg Univ. (Germany, F.R.). Fachbereich Physik; GKSS-Forschungszentrum Geesthacht G.m.b.H., Geesthacht-Tesperhude (Germany, F.R.). Inst. fuer Physik). 1987. 136p. (In German). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88753791/JAW.

The measurement of heavy metal concentration in sediments is of great importance for the assessment of water quality. If dating of the different layers of sediment cores is possible, informations about the history of pollution can be inferred. This paper describes the development and practical test of a procedure suitable for the investigation of sediment cores. Both the element analysis and the dating are based on physical methods. For element concentration determination inductively coupled plasma atomic emission spectrometry (ICP), total-reflection X-ray fluorescence analysis (TXRF) and neutron activation analysis (NAA) are used. The techniques are described and compared. For dating radiometric measurements of / sup 210/Pb and /sup 137/Cs are carried out with a coaxial well-type germanium γ-ray detector in a special low-level arrangement. Results of the systematic investigations are presented and a few individual depth profiles are discussed. (orig.) With 34 figs., 20 tabs.

40493 **(IC—87/260) ESR dating a quaternary travertine.** Lopez Carranza, E.; Amosse, J.; Quiroz, A.; Bouchez, R. (International Centre for Theoretical Physics, Trieste (Italy); Grenoble-1 Univ. (France). Inst. Dolomieu; Universidad Nacional de Ingenieria, Lima (Peru); Grenoble-1 Univ., 38 (France). Inst. des Sciences Nucleaires). (International Centre for Theoretical Physics, Trieste (Italy)). Oct 1987. 12p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702976/JAW.

To study the chronology of the quarternary glaciations in the high Peruvian Andes (3.5-4.0 Km high) a number of samples of travertines was collected in the Oroya-Tarma-Huancayo region. We report, in particular, the ESR measurements realized on samples from Santa Rosa de Sacco, which contain 99% of calcite and show a line of g=2.0046 and of width 8.3G, stable, at least, until ~ 270 deg C. Using the additive dose method to obtain the paleodose and measuring the annual dose by spectrometry gamma of high resolution we obtain for the samples, as a preliminary result, an age between 260,000 and 340,000 a. (author). 7 refs, 6 figs.

40494 **(IKF-IB—65) Evaluation of measured data of activation analysis. Comparison of three numeric methods.** Langfeld, R. (Frankfurt Univ. (Germany, F.R.). Inst. fuer Kernphysik). Dec 1986. 20p. (In German). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88754160/JAW.

The task was to mathematically determine the initial activities of a sample activated by /sup 3/He/sup +/ ions, on the basis of number of decays per time unit. There are three methods available for the case of little free memory space, and lack of high-precision arithmetic. The three methods are explained and evaluated by numeric methods.

40495 **(INIS-BR—1069) Determination of uranium in phosphorite by radiometric measurements and activation analysis.** Santos Amaral, R. dos. (Pernambuco Univ., Recife (Brazil). Dept. de Energia Nuclear). 1987. 124p. (In Portuguese). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88702767/JAW.

Uranium was determined by passive gamma ray counting in phosphate rocks in the range from 50 to 400 ppm U/sub 3/O/sub 8/. The measurements were carried out focusing on the 186 KeV gamma ray from the /sup 235/U nuclide. The radioactive equilibrium of the /sup 226/Ra in the uranium decay chain was investigated due its contribution in the 186 KeV compound /sup 226/Ra /sup 235/U photopeak. Therefore a simulataneous uranium determination through the /sup 234/Th radionuclide demonstrate the equilibrium conditions. The results of the uranium analysis by the following methods: spectrophotometry, XRF and delayed neutrons from three independent laboratories were compared to evaluate the accuracy of the radioanalytical results. The uranium content was also determined by neutron activation analysis, followed by gamma measurement of the /sup 239/Np formed by the /sup 238/U (n,γ) / sup 239/U reaction and /sup 239/U beta decay and the fission products of /sup 235/U. By the correlation of /sup 239/Np, /sup 99/Mo, /sup 143/Ce, /sup 131/I, and /sup 133/I photopeak was measured the /sup 238/U//sup 235/U isotopic ratio.

40496 **(INIS-BR—1070) Measurement of uranium enrichment by 14 MeV neutron irradiation.** Rezende, H.R. (Minas Gerais Univ., Belo Horizonte (Brazil). Curso de Pos-graduacao em Ciencias e Tecnicas Nucleares). 1987. 122p. (In Portuguese). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88702768/JAW.

a non-destructive technique for the determination of uranium in UO/sub 2/ samples was developed, making use of the change in the fission cross section of a nuclide with the neutron energy. The active interrogation method was used by irradiating the samples with pulsed 14 MeV neutrons and further detection of delayed fission neutrons. In order to discriminate U-238 from U-235 the neutron energy was tailored by means of two concentric cylinders of lead and paraffin/poliethylene, 11 and 4 cm thick. Between neutron pulses, delayed neutrons from fission were detected by a long counter built with five BF/sub 3/ proportional counters. Calibration curves for enrichment and total mass versus delayed neutron response were obtained using available UO/sub 2/ pellets of known enrichment. Enrichment detection limit, obtained with 95% confidence level by the Student distribution was estimated to be 0.33%. The minimal detectable mass was estimated to be 4.4 g.

40497 **(INIS-BR—1140) Lanthanides separation by counter - current electrophoretic using α - hydroxyisobutyric acid.** Alleluia, I.B. (Pontificia Univ. Catolica do Rio de Janeiro (Brazil)). 1975. 88p. (In Portuguese). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88703240/JAW.

Studies about counter-current electrophoretic separation of rare earth metal ions using α-hydroxyisobutyric acid as complexing electrolyte are discussed. La, Pr, Nd, Sm and Eu were separated and fractions with purities better than 99,9% were obtained, using neutron activation analysis. A relation between the first stability constant of the α-hydroxyisobutyrate/lanthanide complexes and their migration velocities were observed. (M.J.C.).

40498 **(INIS-mf—11127) Sample preparation of waste water to determine metallic contaminants by X-ray fluorescence spectroscopy.** Gonzalez Olivos, Javier. (Universidad Autonoma del Estado de Mexico, Toluca. Escuela de Ciencias Quimicas). 1987. 57p. (In Spanish). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88703250/JAW.

Trace X-ray fluorescence spectroscopy analysis in liquid samples is preceded by sample preparation, which usually consists in the precipitation of the metallic ions and concentration over a thin cellulose filter. The samples preparation of waste water by this method is not efficient, due to the great amount of organic and insoluble matter that they contain. The purpose of this work was to determine the optimal value of pH in order to adsorbe all the insoluble matter contained in a waste water sample in the activated charcoal, so that the metallic ions could be precipitated and concentrated on a thin filter and determinated by X-ray fluorescence spectroscopy. A survey about the adsorption of some ions in activated charcoal in function of the pH was made for the following: Cr/sup 3+/, Fe/sup 3+/, Ni/sup 2+/, Cu/sup 2+/, Zn/sup 2+/ , Se/sup 2+/, Hg/sup 2+/, and Pb/sup 2+/. It was observed that at pH 0, the ions are not adsorbed, but Cu/sup 2+/ and Zn/sup 2+/ are adsorbed in small amount; at pH 14, the ions are adsorbed, excluding Se, which is not adsorbed at any value of pH. If a waste water sample is treated at pH 0 with activated charcoal to adsorbe the organic and insoluble matter, most of the metallic ions are not adsorbed by the activated charcoal and could be precipitated with APDC (ammonium 1-pirrolidine dithio carbamate salt) and concentrated on a thin filter. The analysis of the metallic ions contained on the filter and those adsorbed in the activated charcoal by X-ray flu-

orescence spectroscopy, gave the total amount of the ions in the sample.

40499 (JAERI-M—88-002) Fundamental study on the extraction of transuranium elements from high-level liquid waste. Survey and classification of extractants. Kubota, Masumitsu; Morita, Yasuji; Tochiyama, Osamu; Inoue, Yasushi. (Japan Atomic Energy Research Inst., Tokyo). Jan 1988. 262p. (In Japanese). NTIS (US Sales Only), PC A12/MF A01. Order Number DE88753622/JAW.

A great many extractants have been studied for the separation of transuranium elements. The present study deals with the survey and classification of the extractants appearing in literature, bearing in mind the relationship between the molecular structure of extractants and their extractability for the transuranium elements from the standpoint of their selective separation from high-level liquid waste (HLW) generated from fuel reprocessing. The extractants surveyed were classified into six groups; unidentate neutral organophosphorus compounds, bidentate neutral organophosphorus compounds, acidic organophosphorus compounds, amines and ammonium salts, N,N-disubstituted amides and the other compounds. These extractants are not always applicable to the separation of transuranium elements from HLW because of their limitations in extractability and radiation durability. Only a limited number of extractants belonging to the bidentate neutral organophosphorus compounds and the acidic organophosphorus compounds are considered to be suitable for the present purpose.

40500 (NSS/R—103) Development of a laser-induced photoacoustic facility for actinide speciation. Ewart, F.T.; McMillan, J.W.; Thomason, H.P.; Liezers, M.; Pollard, P.M. (UKAEA Harwell Lab. Chemistry Div.; Manchester Univ. (UK). Inst. of Science and Technology). (United Kingdom Nirex, Ltd.; UKAEA Harwell Lab. Chemistry Div.; Department of the Environment, London (UK)). Feb 1988. 55p. (AERE-R—12875; DOE-RW—87.116). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88753992/JAW.

A laser induced photoacoustic spectroscopy (LIPAS) facility has been developed at Harwell to measure actinide species in solution with the minimal disturbance of the species equilibria. The novel true dual beam system, which is based on an excimer laser driven dye laser and optical cells mounted on piezoelectric detectors, has high sensitivity and stability, and is capable of detecting Am(III) at ca 10/sup -8/M and Np(IV), (V) and (VI) at ca 10/sup -7/M. Samples can be measured in an inert atmosphere glove box which helps to maintain the anaerobic conditions expected in deep waste repositories. To date, LIPAS has been used to measure actinide species directly in solutions from waste programmes and to observe americium and neptunium species in solutions of varying Eh, pH and carbonate concentration. The information gained is being used to validate the data used in the geochemical/thermodynamic codes used to predict possible radionuclide species within a radioactive waste repository.

40501 (NUCLEBRAS-CDTN—546) Use of radiocarbon technique for archaelogic dating. Chausson, Y. (Centro de Desenvolvimento da Tecnologia Nuclear, Belo Horizonte (Brazil)). 1986. 9p. (In Portuguese). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88701700/JAW.

The nuclear technique based on the beta radiation measurements emitted by the radiocarbon is applied an the geochronological dating of organic samples of prehistoric fires and sambaqui shells. This paper describes the origin of the method, the technique used and its applications, the analysis method, the equipments and the experiences performed.

40502 (PB—88-196001/XAB) Interlaboratory evaluation of SW-846 methods 7470 and 7471 for the determination of mercury in environmental samples. Gebhart, J.E.; Messman, J.D.; Wallace, G.F. (Battelle Columbus Div., OH (USA)). Apr 1988. 69p. NTIS, PC A04/MF A01.

The EPA protocols for SW-846 Methods 7470 and 7471 are cold-vapor atomic absorption spectrometric (CV-AAS) methods for the determination of mercury in aqueous and solid environmental samples. In continuation of a previous single-laboratory study in which a revised more sensitive mercury CV-AAS method for environmental analyses was evaluated, the revised CV-AAS method has been subjected to an interlaboratory study.

40503 (PB—88-199526/XAB) Guidelines for the determination of halogenated dibenzo-p-dioxins and dibenzofurans in commercial products (re-announcement of PB88-101050 - see notes field for explanation). Final report, March 1985-July 1986. Steele, D.H.; Stanley, J.S. (Midwest Research Inst., Kansas City, MO (USA)). Sep 1987. 126p. (MRI—8833-A01). NTIS, PC A07/MF A01.

RE-ANNOUNCEMENT of PB—88-101050, corrected version.

The determination of halogenated dibenzo-p-dioxins (HDDs) and dibenzofurans (HDFs) in commercial products requires specific and sensitive analytical procedures. The development of methods for the measurement of HDD and HDF in commercial products is complicated by the diverse range of matrices, the potentially large number of halogenated (specifically chloro, bromo, or bromo/chloro) HDD and HDF congeners and potential interference due to major components of the product matrices. The report provides (1) a review of the literature pertaining to commercial-product analyses for HDDs and HDFs, (2) detail on the total number of bromo, chloro, and bromo/chloro HDDs and HDFs, (3) a tentative scheme for the analysis of HDDs and HDFs in diverse matrices, and (4) guidelines for the high-resolution gas chromatography/mass spectrometry or electron-capture-detector analysis of commercial products for HDDs and HDFs. The guidelines specify a rigorous QA/QC program for the analysis of the commercial products.

40504 (PB—88-864673/XAB) Laser speckle: theory and applications. January 1970-May 1988 (Citations from the Engineering Index data base). Report for January 1970-May 1988. (National Technical Information Service, Springfield, VA (USA)). May 1988. 97p. NTIS PC N01/MF N01.

Supersedes PB—87-858726.

This bibliography contains citations concerning applications and theoretical considerations pertaining to laser speckle interferometry. Topics include experimental and theoretical investigations, applications in stress and vibrational analysis, velocity and displacement measurement, and surface analysis. Speckle noise-reduction techniques and speckle photography are also treated. (This updated bibliography contains 247 citations, 22 of which are new entries to the previous edition.)

40505 (UJV—7831-CH) Progress in radiochemical determinations using a radioreagent method in the first half of the 1980's. Kyrs, M.; Moravec, A. (Ustav Jaderneho Vyzkumu CSKAE, Rez (Czechoslovakia)). Jun 1987. 17p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703083/JAW.

Procedures published in the period 1980 to 1985 are reviewed and the following topics discussed: separation processes, accuracy and precision, relation to radioimmunoassay and radioreceptor assay, unusual procedures. A brief survey of Shamaev's contributions is given. Typical papers are summarized in a table giving the substance to be determined, radionuclide used, basis and type of the method of determination, accuracy and precision, minimum amount determinable, additional data and references. Conclusions are drawn concerning the development in the pertinent period. (author). 1 fig., 2 tabs., 52 refs.

4002 Inorganic, Organic And Physical Chemistry

REFER ALSO TO CITATION(S) 39060, 39065, 39066, 39067, 39084, 39087, 39202, 39244, 39295, 39298, 39469, 40212, 40213, 40354, 40400, 40460, 40462, 40503, 40575, 40580, 42094

40506 (AD-A—190868/0/XAB) Preparation and characterization of ZrO_2 stabilized with Ru(iv) and La(iii). Technical report. Long, Y.C.; Zhang, Z.D.; Dwight, K.; Wold, A. (Brown Univ., Providence, RI (USA). Dept. of Chemistry). 26 Jan 1988. 9p. (TR—14). NTIS, PC A02/MF A01.

Ruthenium oxide, dispersed on oxide supports such as TiO_2, SiO_2, and ZrO_2, is known to show Fischer-Tropsch activity. Little

is known about the catalyst-support interactions which must play an important role in the catalytic-activity of dispersed ruthenium oxide. The strength of catalytic support interaction may be directly related to the stability of the dispersed catalyst towards reduction. Hence, solid solutions of Ru(IV)/ZrO_2 were prepared, and the resulting stability of Ru(IV) toward reduction with hydrogen was measured and compared with that of bulk RuO_2. The observed increase in stability toward reduction was related to interaction between RuO_2 and ZrO_2. The introduction of a small amount of La_2O_3 with the ZrO_2 produced further stabilization of the Ru(IV) toward reduction.

40507 (AD-A—190891/2/XAB) Unusually large secondary deuterium isotope effect. Thermal trans-cis isomerization of trans-1-phenylcyclohexene. Caldwell, R.A.; Misawa, H.; Healy, E.F.; Dewar, M.J. (Texas Univ., Austin (USA). Dept. of Chemistry). 1987. 3p. NTIS, PC A02/MF A01.

Pub. in Jnl. of the American Chemical Society, Vol. 109, 6869-6870(1987).

The magnitudes of secondary deuterium isotope effects (SDIE) are generally in the range of 0.9 < kH/kD < 1.25, and are often satisfactorily rationalized by the zero-point energy (ZPE) change on going from reactant to transition state due to C-H rehybridization. We now report a far larger SDIE for the title reaction. Its rationalization on the basis of transition-state theory suggests that it more closely resembles a primary isotope effect. Laser flash photolysis of cis-1-phenylcyclohexene (direct, 266 nm, or sensitized by thioxanthone, 355 nm) affords its trans isomer which in heptane exclusively reverts to 1, $k = 2.1 \times 10^6$ s at 300 K. Isotopically substituted 2-2-d1 or 2-2,6-6-d3 (generated similarly from the corresponding cis isomers5) both have rates of reversion longer than 2 itself by a factor of 2.0 at room temperature. No previously reported SDIE approaches this magnitude.

40508 (BNL—52138) Development of techniques for measurement of gas-phase hydrogen peroxide. Shen, J.; Tanner, R.L.; Kelly, T.J. (Brookhaven National Lab., Upton, NY (USA)). Feb 1988. Contract AC02-76CH00016. 55p. NTIS, PC A04/MF A01;1; GPO Dep. Order Number DE88009362/JAW.

The techniques of measuring gas-phase hydrogen peroxide by impinger and diffusion scrubber have been extensively investigated. The mass transfer of collected peroxide in a diffusion scrubber is discussed. The equation describing collection of soluble substances by diffusion scrubber is given for low and high gas flow rates. Gaseous hydrogen peroxide in ambient air can be collected by impinger or scrubber without artifact formation of hydrogen peroxide if O_3 is first removed by gas-phase reaction with nitric oxide. Losses of gas-phase hydrogen peroxide in the sampling tubing and in the scrubber have been quantified. In sampling of gas-phase H_2O_2 in ambient air at Brookhaven National Laboratory and in Los Angeles, a total of 180 samples were collected by impinger and 330 by diffusion scrubber. The ambient levels and the diurnal variation of gas-phase H_2O_2 are discussed and perhaps indicate the range of observed H_2O_2 levels. Data collected simultaneously by impinger and scrubber collection methods are compared, and the causes of lower than predicted recovery efficiency from the scrubber are discussed. 24 refs., 15 figs., 11 tabs.

40509 (CONF-880627—2) Numerical fits of the properties of lithium-bromide water solutions. Patterson, M.R.; Perez-Blanco, H. (Oak Ridge National Lab., TN (USA)). Mar 1988. Contract AC05-84OR21400. 33p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88011378/JAW.

From ASHRAE annual meeting; Ottawa, Canada (25 Jun 1988).

The modelling and design of advanced absorption cycles calls for numerical fits of the working fluids' properties. The numerical fits can be readily implemented in computers. Recently, a worldwide search of available properties of absorption fluids was completed. The present work presents numerical fits of the thermodynamic and transport properties of the lithium bromide water solutions uncovered by the search. The range of existing correlations is extended, and the accuracy of the existing fits improved slightly. A simple test for the thermodynamic consistency of the vapor pressure fit is presented and carried out at one isotherm, with good results. 8 refs., 2 figs., 9 tabs.

40510 (DOE/ER—13169-1) Thermodynamics of systems of very many components. Glandt, E.D. (Department of Energy, Washington, DC (USA). Div. of Chemical Sciences; Pennsylvania Univ., Philadelphia (USA). Dept. of Chemical Engineering). Jul 1987. Contract AC02-84ER13169. 15p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88010804/JAW.

The following topics are briefly discussed: perturbation theory for narrow distributions and wide distributions; computer simulation of dense polydisperse Lennard-Jones mixtures; phase equilibrium for polydisperse mixtures; polydispersity effects on random media. (CBS)

40511 (DOE/ER/13612—2) Infrared study of carbon deposits on bimetallic catalysts: Second annual progress report, September 1, 1987--SEPTEMBER 15, 1988. Eischens, R.P. (Lehigh Univ., Bethlehem, PA (USA). Dept. of Chemistry). 1988. Contract FG02-86ER13612. 4p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE88010905/JAW.

The first objective of this program is to determine the nature of the species which produces bands at 1580 and 1460 cm/sup {minus}1/ in the spectra of coke deposits on catalysts. The second objective is to determine whether the species producing these bands has an especially deleterious effect on catalyst performance and whether the rhenium in bimetallic catalysts ameliorates the effect of this species. Work towards these objectives is discussed. 4 refs.

40512 (DOE/PC/90526—7) Partial oxidation of light alkanes in transition-metal ion containing zeolites: Quarterly report for the period 3/15/88-6/14/88. (Lehigh Univ., Bethlehem, PA (USA). Dept. of Chemistry). 1988. Contract FG22-86PC90526. 20p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88011560/JAW.

Fe(II)-A zeolite has been prepared with 3.3 Fe/sup 2{plus}/ cations per unit cell and characterized by means of diffuse reflectance spectroscopy. Various Fe species have been identified depending on the zeolite treatment: hexaquo Fe/sup 2{plus}/ complex in the hydrated zeolite, trigonal monoaquo Fe/sup 2{plus}/ complex in partially dehydrated zeolite and trigonal surface Fe/sup 2{plus}/ cation in fully dehydrated zeolite. CO and NO adsorption confirmed the accessibilty of the trigonal surface cations. Oxidation with O_2 at 700K resulted in the formation of oxygen-Fe(III) complex having a stoichiometry of one oxygen atom per 2 iron cations. Reduction with CH_4 above 600K regenerated the trigonal surface Fe/sup 2{plus}/ cations together with a small fraction of ferrous precipitates. The reaction of CH_4 with Fe(II)-A resulted in a full oxidation to CO_2 and H_2O under the present experimental conditions. The reduced zeolite was found more active than the fresh Fe(II)-A for the full oxidation of methane, probably due to the presence of covalent ferrous precipitates. 28 refs., 6 figs.

40513 (FNAL-TM—1517-A) Thermophysical properties of argon: Addendum. Jaques, A. (Fermi National Accelerator Lab., Batavia, IL (USA)). May 1988. Contract AC02-76CH03000. 10p. NTIS, PC A02;3. Order Number DE88012722/JAW.

The data presented in these tables were gathered with the use of the Fortran program FLUIDS which was provided by the National Bureau of Standards. Fluid properties at transitional boundaries and points are those obtained with the best fit equation or formula for that particular fluid. Consequently, at such divergent points as the triple and critical points, the accuracy of the properties given by FLUIDS can be off up to 10% in some cases. In listing the critical and triple point conditions within, values were taken from the National Bureau of Standards' publication "Thermodynamic Properties of Argon", not from FLUIDS. Outside of these two points, however, the error in FLUIDS is minimal, thus all other data in these tables were obtained through FLUIDS. The Temperature-Entropy Chart for Argon is also taken from NBS' "Thermodynamic Properties of Argon".

40514 (IC—87/199) Bistability, electric potentials and sensor behaviour in an enzymatic reaction system. Malchow, H.; Felber, F. (International Centre for Theoretical Physics, Trieste (Italy); Humboldt-Universitaet, Berlin (German Democratic Republic). Sektion Physik). (International Centre for Theoretical Physics, Trieste (Italy)). Jul 1987. 18p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702959/JAW.

A special ionic enzyme kinetics in a continuously stirred flow reactor which is membrane coupled to a reservoir is considered starting from a general expression for the substrate dependence of enzymatic reaction rates including pH effects. Both bistability of the reaction and electric potentials between the interior and exterior of the reactor can be observed having regard to mass and charge conservation as well as global electroneutrality. The sudden jumps at critical concentration values from one stable solution branch to the other on a hysteresis loop are supposed to be the basic action principle of a non-equilibrium concentration threshold sensor. (author). 38 refs, 3 figs.

40515 (IC—87/369) Cluster kinetics on surfaces involving addition and decomposition via monomers. Dieterich, W.; Yussouff, M.; Blender, R.; Frisch, H.L. (International Centre for Theoretical Physics, Trieste (Italy); Konstanz Univ. (Germany, F.R.). Fakultaet fuer Physik; State Univ. of New York, Albany (USA). Dept. of Chemistry). (International Centre for Theoretical Physics, Trieste (Italy)). Nov 1987. 15p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702990/JAW.

In an attempt to understand certain features in recent experiments by Klas et al. on the clustering of indium atoms deposited on copper surfaces we study simplified models for the kinetics of clustering via exchange of monomer particles. First we present Monte Carlo simulation results for a two-dimensional diffusion-reaction model. Then we consider an appropriate set of rate equations, which is solved analytically in certain limiting cases. There is good overall agreement between the analytic results, the simulations and the experimental observations. (author). 6 refs, 3 figs.

40516 (IC—87/421) Interchain order and electron-hole photogeneration in trans-polyacetylene. Baeriswyl, D.; Maki, K. (International Centre for Theoretical Physics, Trieste (Italy)). Dec 1987. 26p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703020/JAW.

Two neighbouring trans-polyacetylene chains are modeled individually by the SSH Hamiltonian and coupled by an interchain electron transfer term. Geometrical considerations show that the interchain transfer integrals alternate in size and possibly even in sign. In the latter case parallel ordering of dimerization is favoured. Due to the bonding produced by the splitting of midgap levels for parallel ordering two neutral solitons on neighbouring chains are strongly bound. The binding energy is calculated in the continuum limit using the analogy to the solvable model of a diatomic polymer chain. The direct inter-chain photoproduction of electron-hole pairs is calculated for the two orderings and for polarization perpendicular to the chain axis. It is concluded that this contribution is generally smaller than the intra-chain optical absorption, but close to the threshold $\omega = 2\Delta$ the two contributions are comparable. (author). 15 refs, 3 figs.

40517 (IC—88/20) Extension of the counterion condensation theory to conformational changes of flexible polymers. Benegas, J.C.; Cesaro, A. (International Centre for Theoretical Physics, Trieste (Italy); Trieste Univ. (Italy). Lab. of Macromolecular Chemistry). (International Centre for Theoretical Physics, Trieste (Italy)). Jan 1988. 47p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703163/JAW.

A full report on a statistical model is presented in which an ionic polymer is taken as an aggregate of linear flexible segments (similar to the spring-bead model). This model is thought to represent fairly well some flexible ionic polymers in solution. The model assumes two factorizable energy contributions, one purely conformational the other electrostatic. The first contribution is calculated from distribution function of the end-to-end distances and can be obtained from numerical Monte Carlo calculations of chain conformations. The second contribution is the excess thermodynamic property and is calculated, by using Manning's theory of linear polyelectrolytes, as a function of the degree of ionization and of a number of physical variables. Procedures to evaluate changes in the chain conformation of polysaccharides and polypeptides bearing ionizable charged groups are presented. The results show excellent quantitative agreement of averaged functions and experimental data. They also show that statistical average over the conformational states is not equivalent to the thermodynamic property of the averaged conformation. (author). 37 refs, 17 figs.

40518 (LA—11338-MS) Sesame equation of state number 2293, Li. Boettger, J.C. (Los Alamos National Lab., NM (USA)). Aug 1988. Contract W-7405-ENG-36. 11p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88012687/JAW.

A new equation of state (EOS) for Li has been constructed and placed on the SESAME library as material number 2293. This new equation of state uses a cold curve obtained via electronic band structure calculations using the linear-muffin-tin-orbitals (LMTO) techique. 15 refs., 5 figs.

40519 (LBL—23848) Groupings of organic waste chemicals based on sorption, biotransformation and hydrolysis at standard conditions for application to the deep subsurface environment. Phillips, S.L.; Hale, F.V.; Tsang, C.F. (Lawrence Berkeley Lab., CA (USA)). Jan 1988. Contract AC03-76SF00098. 186p. NTIS, PC A09/MF A01;1; GPO Dep. Order Number DE88008405/JAW.

Chemical and biological reactions of organic hazardous wastes disposed to injection wells at depths down to 7000 feet deep are assessed. At these depths, the major reactions involving organic wastes include hydrolysis, biotransformation and sorption. However, experimental data on reactions of organics in the deep subsurface are sparse or nonexistent. Tables are given on values for hydrolysis, sorption and biotransformation reactions obtained from research publications, mostly at 25{degree}C and atmospheric pressure. It is suggested that the more plentiful data on reactions at the land surface be used to approximate the rates of hydrolysis and biotransformation and sorption equilibrium by taking into account the expected subsurface environment. For example, predictive methods will take into consideration a deep subsurface environment which has: a higher temperature and pressure than the land surface; fewer kinds of microorganisms and a substantially lower concentration of microorganisms; lower organic carbon levels; and, highly saline ground waters. 58 refs., 1 figs., 12 tabs.

40520 (LBL—24543) The use of basic polymer sorbents for the recovery of acetic acid from dilute aqueous solution. Garcia, A.A.; King, C.J. (Lawrence Berkeley Lab., CA (USA)). Jan 1988. Contract AC03-76SF00098. 141p. NTIS, PC A07/MF A01;1; GPO Dep. Order Number DE88008392/JAW.

Measurements were made of preferential uptakes of acetic acid from aqueous solution onto basic polymer sorbents. Individual uptakes of water and acetic acid were measured as well. The sorption equilibria were interpreted through a chemical complexation model yielding sorption affinities and capacities for acetic acid. Basicity scales, such as pKa and Gutmann Donor Number (DN) based upon the monomeric functional group chemistry, were shown to explain the trends in sorption affinities. The use of different solvents to leach sorbed acetic acid from basic polymer sorbents was investigated as a means of regenerating the sorbents. It was found that regeneration can be improved by using solvents of high donicity. Aqueous ammonia proved to be effective for regenerating moderately strong base sorbents. 83 refs., 51 figs., 11 tabs.

40521 (PB—88-863238/XAB) Organic solvent recovery and reclamation, June 1970-April 1988 (Citations from the Engineering Index data base). Report for June 1970-April 1988. (National Technical Information Service, Springfield, VA (USA)). Apr 1988. 91p. NTIS PC N01/MF N01.

Supersedes PB—87-857579.

This bibliography contains citations concerning extraction, recovery, and reclamation of solvents and components of solvents

which are utilized in various mineral, manufacturing, processing, and reprocessing industries. Design, operation, performance, and maintenance of equipment utilized for this purpose are included. (This updated bibliography contains 216 citations, 39 of which are new entries to the previous edition.)

40522 **(SAND—88-0364C) Synthesis of organometallic mixed sulfur-selenium π-acceptor molecules.** Nigrey, P.J. (Sandia National Labs., Albuquerque, NM (USA)). 1988. Contract AC04-76DP00789. 8p. (CONF-880669—2). NTIS, PC A02/MF A01;1; GPO Dep. Order Number DE88011814/JAW.

From International conference on science and technology of synthetic metals; Santa Fe, NM, USA (26 Jun 1988).

The relative dianion, 4,5-diselenolato-1,3-dithiole-2-thione (dsit) was prepared by the reaction of 1,3-dithiole-2-thione with in-situ generated lithium diisopropylamide and finely powdered elemental selenium. Addition of methanolic-ammoniacal solutions of the appropriate metal (nickel and palladium) dichlorides to the above reaction mixture followed by methanolic solutions of tetraalkylammonium [tetrabutylammonium (TBA) and tertraethylammonium (TEA)] bromide, results in the precipitation of dark colored solids from the solutions. Isolation and purification of these solids revealed that the solids had the general composition $(TAA)_2[M(dist)_2]$ where TAA were tetrabutylammonium or tetraethylammonium anions and M were Ni(II) and Pd(II). Electrochemical or chemical oxidation of the nickel(II) organometallic complexes resulted in the formation of the π-acceptor (TBA) [Ni(dsit$_2$)] while a similar reaction with the palladium(II) complexes failed to produce the equivalent (TAA) $[Pd(dsit)_2]$. 12 refs., 1 tab.

40523 **(STU—81-5209) X-Ray Photoemission Spectroscopy (XPS) study of zeolite catalysts containing metal impurities. Sample, preparation, sample indtroduction chamber, and spectroscopic results.** Nordin, S.A.; Kasemo, B. (Swedish National Board for Technical Development, Stockholm). 15 Sep 1986. 28p. (In Swedish). NTIS (US Sales Only), PC A03. Order Number DE88753750/JAW.

Within the scope of the investigation the following tasks were accomplished: - Construction of XPS (including electronic detection) in connection with an existing ultrahigh vacuum system and electron spectrometer. - Design of sample introduction system with heated sample holder for zeolite catalysts. - Development of process for sample preparation by pressing, followed by porosity determination together with X-ray diffraction study of the prepared samples to ensure the samples to be physically unchanged by the preparation. - XPS analyses of equilibrium catalysts and of impregnated catalysts. - Preliminary investigation of motor car exhaust gas catalysts. The following conclusions are drawn. 1. Sample introduction chamber works satisfactory i.e. very good. 2. Preparation method yields samples with still relevant properties. 3. The level of metal content of equilibrium catalysts is to low to yield chemical information by XPS technique. 4. Impregnated samples with the same average percentage of Ni, V as in item 3 above yield Ni and V signals which can be analyzed by XPS technique. Results from item 3 and 4 indicate that samples impregnated by the technique used in this investigation will not be relevant. 5. Preliminary measurements taken on motor car exhaust gas catalysts show that the equipment is well suited for study of those catalysts. (O.S.).

40524 **Kinetic determinations and some kinetic aspects of analytical chemistry.** Mottola, H.A.; Perez-Bendito, D.; Mark, H.B. Jr. (Oklahoma State Univ., Stillwater (USA)). *Analytical Chemistry;* **60**: No. 12, 181R-200R(15 Jun 1988).

This review retains, basically, the organizational structure of previous ones in this series. The papers reviewed have been selected from those that appeared since November 1985 and were available for the authors' consideration through approximately November 1987.

40525 **Chemometrics.** Brown, S.D.; Barker, T.Q.; Larivee, R.J.; Monfre, S.L.; Wilk, H.R. (Univ. of Delaware, Newark (USA)). *Analytical Chemistry;* **60**: No. 12, 252R-273R(15 Jun 1988). Contract FG02-86ER13542.

Chemometrics, the application of statistical and mathematical methods to chemistry, continues to grow and mature as a field. This review covers some of the more significant developments in the field of chemometrics during the period from December 1985 to December 1987. This review is the seventh of the series, and the fifth with the title Chemometrics.

40526 **Improved ab initio calculations of amplitude and phase functions for extended x-ray absorption fine structure spectroscopy.** McKale, A.G.; Veal, B.W.; Paulikas, A.P.; Chan, S.K.; Knapp, G.S. (Argonne National Lab., IL (USA)). *Journal of the American Chemical Society;* **110**: No. 12, 3763-3768(8 Jun 1988). Contract W-31-109-ENG-38.

Extended X-ray absorption fine structure (EXAFS) backscattering amplitude and phase functions have been calculated from first principles for K and L edges for nearly every element in the periodic table by using a full curved wave formalism. These functions are tabulated for approximately half of the elements from boron through californium. The functions are calculated for the range $2 \leq k \leq 20$ A^{-1}, thus extending the range of currently available calculations to both higher and lower k. The range of elements has also been extended to include the actinide series. Because a curved wave formalism has been used for these calculations, the functions for L/sub III/ absorption edges are different from those of K (or more generally, s-shell) absorption edges. Variations of the functions for K and L/sub III/ absorption are illustrated. These ab initio calculations can be used in EXAFS data analysis to provide structural (interatomic distances) and chemical (type of neighboring atoms, Debye Waller factor) information with improved accuracy.

40527 **New structural insights into the iron-molybdenum cofactor from azotobacter vinelandii nitrogenase through sulfur K and molybdenum L x-ray absorption edge studies.** Hedman, B.; Frank, P.; Gheller, S.F.; Roe, A.L.; Newton, W.E.; Hodgson, K.O. (Stanford Synchrotron Radiation Lab., CA (USA)). *Journal of the American Chemical Society;* **110**: No. 12, 3798-3805(8 Jun 1988).

The electronic and structural nature of sulfur and molybdenum in the FeMO cofactor (FeMO-co) isolated from Azotobacter vinelandii MoFe protein has been studied by X-ray absorption edge and near-edge spectroscopy (referred to herein collectively as XANES) at the sulfur K and molybdenum L_3 and L_2 absorption edges. In contrast to the relatively poor resolution found for X-ray absorption edges at higher energies (e.g., several electronvolts at the molybdenum K edge at 20 keV), resolution in the 2.5-3.0-keV region is significantly improved (e.g., 0.5 eV at the sulfur K edge at 2.47 keV), resulting in more edge structure with higher sensitivity to changes in electronic and structural environment. In order to record spectra from dilute samples at these low energies, an experimental method that takes advantage of the higher flux synchrotron radiation from an undulator magnet has been developed. XANES spectra have been recorded for FeMo-co in the oxidized (ox) and semireduced (s-r) forms and, for comparison, a number of inorganic complexes containing molybdenum and sulfur. To remove the interference of dithionite, its decomposition products, and other small, unbound molecules from the FeMo-co spectrum, an anaerobic column chromatographic method of purification has been developed. The spectrum of dithionite-free FeMo-co in the oxidized form could thus be recorded.

40528 **Determination of gas-phase ligand binding energies to Mg^+ by FTMS techniques.** Operti, L.; Tews, E.C.; Freiser, B.S. (Purdue Univ., West Lafayette, IN (USA)). *Journal of the American Chemical Society;* **110**: No. 12, 3847-3853(8 Jun 1988). Contract FG02-87ER13766.

Relative and absolute gas-phase binding energies of 12 organic molecules to Mg^+ have been determined by four different methods involving Fourier transform mass spectrometry (FTMS). Mg^+ is generated in the FTMS cell by pulsed laser ionization and reacts with the organic compounds to give MgL^+ either by direct condensation or by a fast two-step displacement reaction. The equilibrium constant (K/sub eq/) and the absolute rate constants (k/sub f/ and k/sub r/) are obtained for the ligand exchange reaction: $MgL^+ + L'$ reversible $MgL'^+ + L$. The equilibrium constants are converted to free-energy differences and relative binding energies are calculated to give the $D^0(Mg^+\text{-}L)$ scale. Entropy changes are assumed to be small and they are discussed in detail. The absolute

gas-phase binding energies $D^0(Mg^+\text{-MeOH})$ and $D^0(Mg^+\text{-Me}_2CO)$ are assigned from equilibrium and photodissociation experiments to be 61 +/- 5 and 67 +/- 5 kcal/mol, respectively. The correlation of results from the different methods give a scale of relative and absolute bond energies to Mg^+ for the 12 organic molecules examined. The results for Mg^+ are compared with previously reported results on H^+, $CpNi^+$, Al^+, Mn^+, and Cu^+. These comparisons show for this limited study on oxygen bases that Mg^+ is a softer acid than H^+ and Al^+, very similar to acidity to Mn^+ and Cu^+, and a harder acid than $CpNi^+$.

40529 **Ionic hydrogen bond and ion solvation. 6. Interaction energies of the acetate ion with organic molecules. Comparison of CH_3COO^- with Cl^-, CN^-, and SH^-.** Meot-Ner Mautner, M. (National Bureau of Standards, Gaithersburg, MD (USA)). *Journal of the American Chemical Society;* **110**: No. 12, 3854-3858(8 Jun 1988).

The interaction energies of CH_3COO^- with protic and aprotic molecules were measured by pulsed high-pressure mass spectrometry. The attachment energies of the first three water molecules are 15.8, 12.8, and 11.8 kcal/mol. The rapid approach to $\Delta H/$ sub condsn/(H_2O) shows that ionic interactions are accounted for mostly by the first two solvent molecules. CH_3COO^- hydrogen bonds strongly to NH acids such as pyrrole, amides, and aniline, with $\Delta H°/\text{sub D}/$ = 25-31 kcal/mol. With the carbon acids CH_3CHO, CH_3COCH_3, and CH_3CN as ligands, the attachment energies are 14-16 kcal/mol and the interactions may involve multiple O^-..HC bonds. Despite the fact that the ions CH_3COO^-, Cl^-, CN^-, and SH^- differ in size, structure, electronegativity, isotropy, and available bonding sites, they bond with similar strengths to most OH, NH, and CH hydrogen donors, from H_2O to large organic molecules such as the dipeptide analogue $CH_3CO\text{-Ala-}OCH_3$. Also, the four ions show similar clustering energies with n H_2O and HCN molecules (n = 1-4).

40530 **Ionic hydrogen bond and ion solvation. 7. Interaction energies of carbanions with solvent molecules.** Meot-Ner Mautner, M. (National Bureau of Standards, Gaithersburg, MD (USA)). *Journal of the American Chemical Society;* **110**: No. 12, 3858-3862(8 Jun 1988).

The bonding energy of a water molecule to carbanions ranges from 11.0 kcal/mol for $c\text{-}C_5H_5^-$ to 13-15 kcal/mol for CH_3CH^-, CH_2CHO^-, and $CH_2COCH_3^-$ and to 16.2 kcal/mol for HCC^-. Alcohols bond to $c\text{-}C_5H_5^-$ more strongly, by up to 20.6 kcal/mol for the strongly acidic CF_3CH_2OH, and the attachment energies show an inverse linear correlation with the acidities of the alcohols. The $c\text{-}C_5H_5^-$ ion exhibits unusual behavior in that it bonds to the hydrogen donor H_2O more weakly (11.0 kcal/mol) than to CH_3CN (15.5 kcal/mol). In contrast, the more localized pyrrolide ion $c\text{-}C_4H_4N^-$ bonds to the two solvents by comparable strength, 15.8 and 15.7 kcal/mol, respectively. These observations indicate a specific N^- x OH hydrogen bonding contribution in $c\text{-}C_4H_4N^-$ x H_2O, and/or an unusual C^- x HC type hydrogen-bonding contribution in $c\text{-}C_5^-$ x CH_3CN. As to structures, correlations between $\Delta H°/\text{sub D}/$ and $\Delta H°/\text{sub acid}/$ suggest that ligands may hydrogen bond to the π system of $c\text{-}C_5H_5^-$, and to the oxygen atoms in CH_3CHO^- and $CH_3COCH_2^-$. The latter is also supported by solvent shell effects in $CH_3COCH_2^-$ x nH_2O.

40531 **New crystalline phase of (octaethylporphinato)nickel(II). Effects of π-π interactions on molecular structure and resonance Raman spectra.** Brennan, T.D.; Scheidt, W.R.; Shelnutt, J.A. (Univ. of Notre Dame, IN (USA)). *Journal of the American Chemical Society;* **110**: No. 12, 3919-3924(8 Jun 1988). Contract AC04-76DP00789.

A new (third) crystalline phase of Ni(OEP) has been isolated and characterized by a single-crystal X-ray diffraction study and single-crystal resonance Raman spectroscopy. Single-crystal Raman measurements were also performed on the two previously described phases and the Raman spectra of the three phases compared. Differences in Raman spectra between the current new phase and the previously reported triclinic phase are interpreted in terms of π-π interactions found for this new phase. These spectral differences are also compared to solution Raman data that had been previously reported on aggregated and monomeric porphyrin derivatives. The bands most affected are the core-size marker bands ν_{10}, ν_{19}, and ν_3 and the oxidation-state marker band ν_4 where π-π interaction leads to increases of 2.5-4.3 cm^{-1}. These Raman shifts are consistent with a decrease in the core size, and the crystal structure confirms this interpretation. The two crystallographically distinct Ni-N bond distances in the new crystalline phase are 1.946 (4) and 1.958 (4) A, with the shorter distance along the one-dimensional stack axis of the complex. The observed interplanar spacing between porphyrin planes is 3.44 A, and the Ni...Ni separation is 4.80 A. Crystal data: triclinic; space group P anti 1; a = 13.302 (6), b = 13.342 (11), c = 4.802 (2) A; α = 92.21 (2), β = 93.52 (4), γ = 113.43 (6)°, Z = 1; V = 778.7 A^3.

40532 **Steric and electronic interactions between cofacial metallocene rings.** Arnold, R.; Foxman, B.M.; Rosenblum, M.; Euler, W.B. (Brandeis Univ., Waltham, MA (USA)). *Organometallics;* **7**: No. 6, 1253-1259(Jun 1988).

As part of a study of interactions between metallocenes, held so that two cyclopentadienyl rings are constrained to be proximate and facing one another, 1,8-diruthenocenylnaphthalene has been prepared and its crystal structure has been determined. This structure is shown to be close to that of 1,8-diferrocenylnaphthalene reported earlier, especially in respect to the dihedral angle between the substituted cyclopentadienyl and naphthalene ring planes and the splay angle between the two substituted cyclopentadienyl rings. Both of these distortions are significantly diminished in the monocation derived from 1a, suggesting that there is a significant decrease in electron density on the cyclopentadienyl rings on oxidation of ferrocene to a ferricenium cation, consistent with theoretical analyses.

40533 **Electron transfer versus energy transfer in the reactions of ^2E $Cr(bpy)_3^{3+}$ with organochromium and organocobalt complexes.** Bakac, A.; Espenson, J.H. (Iowa State Univ., Ames (USA)). *Journal of the American Chemical Society;* **110**: No. 11, 3453-3457(25 May 1988). Contract W-7405-ENG-82.

The pentaaquoorganochromium complexes, $(H_2O)_5CrR^{2+}$, and a series of organocobalt complexes, $(H_2O)([14]aneN_4)CoR^{2+}$ ([14]$aneN_4$ = 1,4,8,11-tetraazacyclotetradecane), quench the luminescence of ^2E $Cr(bpy)_3^{3+}$. The kinetic trend in the reactions of $(H_2O)_5CrR^{2+}$ at 25°C (R, 10^{-7}k/sub Cr//M^{-1} s^{-1}: CH_3, ~ 0.15; C_2H_5, 1.9; 2-C_3H_7, 32; $CH_2C_6H_5$, 157; CH_2OCH_3, 8.5; CH_2Cl, ~ 0.1) is that expected for outer-sphere electron transfer to ^2E $Cr(bpy)_3^{3+}$. The organocobalt complexes are generally more reactive, but the reactivity pattern (R, 10^{-7}k/sub Co//M^{-1} s^{-1}: CH_3, 9.4; C_2H_5, 13; 1-C_3H_7, 2.7; CH_2OCH_3, 5.2; CH_2Cl, 22; CH_2Br, 35) is clearly distinct from that observed in the organochromium series. The oxidation of the organocobalt complexes by $Ru(bpy)_3^{3+}$ shows a pattern that is typical of outer-sphere electron transfer (R, k/M^{-1}: CH_3, 16.0; 1-C_3H_7, 442; CH_2OCH_3, 649; CH_2Cl, < 0.04; CH_2Br, < 0.4). The unusual reactivity trend in the reactions of the organocobalt complexes with $Cr(bpy)_3^{3+}$ thus signals a major change in mechanism. It is proposed that the cobalt complexes react by energy transfer to yield $^*(H_2O)Co([14]aneN_4)R^{2+}$ and $Cr(bpy)_3^{3+}$. The relaxation of $^*(H_2O)Co([14]aneN_4)R^{2+}$ to the ground state takes place in competition with the unimolecular homolysis to yield $Co([14]aneN_4)(H_2O)/\text{sub n}/^{2+}$ and R/sup ./.

40534 **Methyl viologen mediated oxidation-reduction across dihexadecylphosphate vesicles involves transmembrane diffusion.** Patterson, B.C.; Thompson, D.H.; Hurst, J.K. (Oregon Graduate Center, Beaverton, (USA)). *Journal of the American Chemical Society;* **110**: No. 11, 3656-3657(25 May 1988). Contract FG06-87ER13664.

Numerous reports have appeared describing oxidation-reduction across bilayer membranes. Mechanisms proposed for specific systems include the following: (i) electron tunneling across the hydrocarbon barrier between interfacially bound redox partners, (ii) molecular diffusion of bound redox components across the barrier, and (iii) formation of barrier-penetrating aggregates, or electron-conducting channels, across the bilayer. Nonetheless, the actual reaction mechanisms remain obscure due to the general unavailability of transverse diffusion rates, possible loss of compartmentation of reactants, particularly in photochemical systems, and the ambiguities inherent in deducing reaction mechanisms from rate data,

which form the primary evidence in most systems studied. The reactions of dihexadecylphosphate (DHP) vesicle-bound methyl viologen (MV^{2+}) describes in this report are unique in allowing deduction of molecular details of a transmembrane redox event from the product composition and microphase distribution. Specifically, they have found that MV^{2+} bound at the outer vesicle interface mediates reduction of inner-localized MV^{2+} by dithionite ion in bulk solution in a manner that requires comigration of MV^{+} with the electron transferred across the membrane barrier.

40535 Time-resolved ESR study of the kinetics of spin trapping by nitromethane aci-anion. Madden, K.P.; Taniguchi, H.; Fessenden, R.W. (Univ. of Notre Dame, IN (USA)). *Journal of the American Chemical Society;* **110**: No. 9, 2753-2758(27 Apr 1988).

The kinetics of spin trapping by the aci-anion of nitromethane have been studied for some representative radicals in aqueous solution by using time-resolved ESR with in situ radiolysis. In nearly all cases, reaction of a radical R produced an adduct $RCH_3NO_2^-$. However, these time-resolved experiments showed that /sup ./CH_2O^- produces both an adduct and the radical anion of nitromethane. Second-order rate constants varied from 1.4×10^7 M^{-1} s^{-1} for CO_2^- to 3.8×10^8 for the p-carboxyphenyl radical. Reducing radicals (CO_2^-, CH_2O^-, $(CH_3)^2COH$, and $(CH_3)_2CO^-$) react less rapidly than alkyl radicals ($CH_2CO_2^-$, CH_3) which in turn react less rapidly than σ radicals (p-carboxyphenyl and $CONH_2$).

40536 Liquid encapsulated float zone process and apparatus. Naumann, R.J.; Frazier, D.O.; Lehoczky, S.L.; Facemire, B.R. (to Administrator of the National Aeronautics and Space Administration, Washington, DC). US Patent 4,740,264. 26 Apr 1988. Filed date 29 Oct 1986. vp. Patent and Trademark Office, Box 9, Washington, DC 20232.

The process of growing crystals is described which comprises: placing an elongated rod of crystalline material having a seed crystal disposed in contact with one end thereof into a closed container having walls larger than the rod so as to provide an open space therebetween; filing the open space with an encapsulant having a slightly lower melting point than the crystalline material; heating the container to temperature such as to melt the encapsulant, but not the crystalline material, the rod becoming covered with molten encapsulant; venting off-gas produced upon the heating step away from the encapsulant covered rod; pressurizing the molten encapulant covering the rod so as to terminate the venting after a releasing of the off-gas and prevent loss of volatile components upon melting of the rod; passing the container through a heated zone transverse to the rod such that a molten region forms at the seeded end of the rod and progresses longitudinally through the rod as the container moves through the heated zone. The rod re-solidifies as it moves out of the heated zone.

40537 Second harmonic generation from Langmuir-Blodgett films of retinal and retinal Schiff bases. Huang, J.; Lewis, A.; Rasing, T. (Cornell Univ., Ithaca, NY (USA)). *Journal of Physical Chemistry;* **92**: No. 7, 1756-1759(7 Apr 1988). Contract AC03-76SF00098.

The second harmonic signal from monolayers of retinal and retinal Schiff bases is reported. The results have yielded information on the monolayer structure and demonstrate that retinal and retinal Schiff bases have large second-order molecular hyperpolarizabilities with values of 1.4×10^{-28}, 1.2×10^{-28}, and 2.3×10^{-28} esu for retinal, the unprotonated Schiff base, and the protonated Schiff base, respectively. These values compare well with the known variation in the alteration in the dipole moment of such chromophores upon excitation.

40538 A kinetic modeling study of n-pentane oxidation in a well-stirred reactor. Westbrook, C.K.; Pitz, W.J.; Thornton, M.M.; Malte, P.C. (Lawrence Livermore National Lab., Livermore, CA (US)). *Combustion and Flame;* **72**: No. 1, 45-62(Apr 1988).

Oxidation of n-pentane in a well-stirred reactor is examined, using a numerical model and a detailed chemical kinetic reaction mechanism, including 53 chemical species and 326 elementary reactions. Temperatures studied range from 1068K to 1253K, and the pressure is atmospheric. The major reaction paths consuming n-pentane are H-atom abstraction by OH radicals, followed in importance by H-atom abstraction by H and O atoms and the unimolecular decomposition to produce ethyl and n-propyl radicals. Logically distinguishable H atom sites in n-pentane are treated separately, and decomposition of the three different types of pentyl radicals via B-scission is found to dominate over isomerization through internal H atom transfer or reaction with molecular oxygen. Computed and measured results for chemical species concentrations show substantial agreement at temperatures below 1200K. However, at higher temperatures, the computed oxidation of the n-pentane is more rapid than measured. In the experiments, n-pentane oxidation does not become so rapid as to cause a clear breakdown is reactor homogeneity until the temperature exceeds 1260K. Modifications in some of the elementary reaction rate constants were found to produce much better agreement between computed and measured results in the temperature range from 1200 to 1260K. Explanations for this behavior are discussed, using a detailed sensitivity analysis of the computational model results.

40539 A theoretical and numerical study of radiative ignition and deradiative extinction in solid propellants. Armstrong, R.C.; Koszykowski, M.L. (Combustion Research Facility, Sandia National Labs., Livermore, CA (US)). *Combustion and Flame;* **72**: No. 1, 13-26(Apr 1988).

Time-dependent processes of solid propellant deflagration are modeled and a numerical simulation of ignition and extinction is undertaken. since the analytic theory of ignition is well developed we rely on it to verify the ability of the numerical algorithm to track stiff, time-dependent features of an ignition event. The verification of our numerical method provides a degress of confidence for the subsequent study of deradiation, which is less well understood. An activation energy asymptotic theory for deradiation is developed, which predicts that an influx of radiation on the order of the steady heat release of the exothermic reaction will, at near term, extinguish the propellant. Beyond this, conduction processes inherited from the thermal profile at the instant of deradiation may, or may not, cause resumption of pyrolysis, and presumably, the deflagration as a whole. The analytic theory ignores the subsequent impact of a possible gas-phase flame that is detached many conductive-diffusive lengths away from the gas/solid surface. The assumption is based on the observation that for most physical systems the gas density-and hence its thermal capacitance-is many times smaller than that of the solid and thus lacks the potential to alter the surface temperature after deradiation. The simulation is used to verify more complicated and more physical situations than those accessible via the theory, including deradiation with a detached flame and in the presence of an instability.

40540 Rhodium-carbon monoxide surface chemistry: the involvement of surface hydroxyl groups on Al_2O_3 and SiO_2 supports. Basu, P.; Panayotov, D.; Yates, J.T. Jr. (Univ. of Pittsburgh, PA (USA)). *Journal of the American Chemical Society;* **110**: No. 7, 2074-2081(30 Mar 1988).

Direct spectroscopic evidence has been obtained indicating that specific OH groups on Al_2O_3 and SiO_2 are consumed as CO interacts with supported Rh crystallites to produce atomically dispersed Rh/sup I/$(CO)_2$(a). The reaction (1/x)Rh/sub x/^{0} + OH(a) + 2CO(g) → Rh/sup I/$(CO)_2$(a) + (1/2)H_2(g) has been shown to involve isolated OH(a) groups rather than H-bonded associated OH(a) species. The process may also be reversed upon treatment of the chemisorbed CO layer with H_2(g) at temperatures above ~ 200 K. With the H_2 treatment, Rh/sup I/$(CO)_2$(a) species are converted back to Rh/sub x/^{0} species as judged by changes in the IR spectrum where terminal CO(a) species (on Rh/sub x/^{0} sites) and isolated OH(a) groups are regenerated. Comparative kinetic studies of OH(a) and OD(a) species indicate that the rate controlling step in the production of Rh/sup I/$(CO)_2$(a) does not exhibit a measurable kinetic isotope effect.

40541 Electronic spectra and chemical reactivity. Pearson, R.G. (Univ. of California, Santa Barbara (USA)). *Journal of the American Chemical Society;* **110**: No. 7, 2092-2097(30 Mar 1988).

Perturbation theory suggests a close relationship between the electronic spectra of molecules and energy barriers to possible uni-

molecular and bimolecular reactions. Considering only v/sub max/, the vertical frequency of the lowest excited state (of the same multiplicity), a number of interesting correlations can be made. It is necessary (a) to compare only groups of related molecules and (b) to use elementary spectroscopic theory to identify the nature of the lowest excited state. The relationship between vis-UV spectra and the stability of isomers is discussed.

40542 Multicomponent redox catalysts for reduction of large biological molecules using molecular hydrogen as the reductant. Chao, S.; Simon, R.A.; Mallouk, T.E.; Wrighton, M.S. (Massachusetts Institute of Technology, Cambridge (USA)). *Journal of the American Chemical Society;* 110: No. 7, 2270-2276(30 Mar 1988).

One-electron reduction of the large biological molecules horse heart cytochrome c, sperm whale myoglobin, and horseradish peroxidase using H_2 as the reductant can be catalyzed by two-component, high surface area heterogeneous catalysts. The catalysts can be prepared by first functionalizing high surface area SiO_2 with a polycationic polymer into which is dispersed MCl_4^{2-} (M = Pd, Pt). Reduction with H_2 yields elemental Pd or Pt dispersed in the polymer. The particles are finally functionalized with a redox polymer derived from hydrolysis of $Si(OR)_3$ groups of an N,N'-dialkyl-4,4'-bipyridinium- or from a cobalticenium-based monomer. The two components of the heterogeneous catalysts are the buried noble metal capable of activating the H_2 and the redox polymer, which can equilibrate both with the noble metal and with the large biological molecule. Reduction of the large biological molecules in aqueous solution can be effected at room temperature and 1 atm H_2 using the catalysts under conditions where the biological materials would not be reducible with H_2 alone or when the noble metal alone would be used as the catalyst.

40543 Structural characterization by EXAFS spectroscopy of the binuclear iron center in protein A of methane monooxygenase from methylococcus capsulatus (bath). Ericson, A.; Hedman, B.; Hodgson, K.O.; Green, J.; Dalton, H.; Bentsen, J.G.; Beer, R.H.; Lippard, S.J. (Stanford Univ., CA (USA)). *Journal of the American Chemical Society;* 110: No. 7, 2330-2332(30 Mar 1988).

Soluble methane monooxygenase (MMO) from Methylococcus capsulatus (Bath) activates dioxygen for incorporation into a remarkable variety of substrates including methane, which is required for bacterial growth (eq 1). MMO is a three component CH_4 + NADH + H^+ + O_2 /sup MMO/ → CH_3OH + NAD^+ + H_2O (1) enzyme. Protein A (M/sub r/ 210,000), believed to be the oxygenase component, contains two iron atoms. Protein B (M/sub r/ 15,700) serves a regulatory function and lacks prosthetic groups, while protein C, the reductase component of the enzyme, is an iron-sulfur flavoprotein (M/sub r/ 42,000) responsible for electron transfer from NADH to protein A. Recently, a binuclear iron center was postulated to occur in protein A based on the finding that one-electron reduction gives rise to electron spin resonance (ESR) signals (g 1.95, 1.88, 1.78) very similar to those observed for the binuclear mixed-valence Fe_2(III,II) centers in semimet hemerythrin (Hr) and purple acid phosphatase (PAP). In conjunction with model studies, extended X-ray absorption fine structure (EXAFS) spectroscopy has proven to be a powerful method for identifying bridged binuclear iron centers in Hr, ribonucleotide reductase (RR), and PAP. Here the authors report iron K-edge EXAFS results on semireduced protein A of MMO which support the occurrence of a binuclear iron center (Fe-Fe distance, 3.41 A), with no short μ-oxo bridge.

40544 Algorithms and accuracy requirements for computing reaction paths by the method of steepest descent. Garrett, B.C.; Redmon, M.J.; Steckler, R.; Truhlar, D.G.; Baldridge, K.K.; Bartol, D.; Schmidt, M.W.; Gordon, M.S. (Chemical Dynamics Corporation, Marlboro, MD (USA)). *Journal of Physical Chemistry;* 92: No. 6, 1476-1488(24 Mar 1988). Contract AC02-79ER10425;FG02-86ER13579.

The authors present several algorithms for computing minimum energy reaction paths by the method of steepest descents of the potential energy and for interpolating reaction-path potentials. The algorithms are suited for use with global analytic potential surfaces or ab initio calculations of energies and gradients. The efficiencies of the various algorithms are demonstrated and compared by applications to several test cases.

40545 Kinetics of CO oxidation by O_2 or NO on Rh(111) and Rh(100) single crystals. Peden, C.H.F.; Goodman, D.W.; Blair, D.S.; Berlowitz, P.J.; Fisher, G.B.; Oh, S.H. (General Motors Research Laboratories, Warren MI (USA)). *Journal of Physical Chemistry;* 92: No. 6, 1563-1567(24 Mar 1988). Contract AC04-76DP00789.

The oxidation of CO by O_2 or NO over Rh(111) and Rh(100) single crystals has been studied in a high-pressure reaction-high-vacuum surface analysis apparatus. Steady-state catalytic activity as a function of temperature and partial pressures of CO, O_2, and NO has been measured. The CO-O_2 reaction was found to be insensitive to the structure of the surface as evidenced by the identical rates, activation energies, and partial pressure dependencies measured on the two-single-crystal surfaces. Both surfaces deactivated at high O_2 partial pressures to the formation of a near-surface oxide (probably Rh_2O_3) which is catalytically inactive for this reaction. The deactivation occurred at a slightly lower O_2 partial pressure on Rh(100), likely due to the relative ease of oxygen diffusion through this surface leading to more rapid bulk oxidation. Unlike the CO-O_2 reaction, CO oxidation by NO was very sensitive to the geometric structure of the surface. This behavior was evident in all kinetic parameters measured on the two surfaces. The kinetic data obtained on Rh(111) agree quantitatively with a surface chemistry model previously developed for this reaction. The model predicts that the rate is limited by the formation of N_2 from the recombination of adsorbed N atoms. and that the surface, under steady-state reaction conditions, is covered largely with adsorbed N atoms and smaller amounts of adsorbed NO. On Rh(100) the data are consistent with a reaction rate limited by the formation of N_2 from the surface reaction of adsorbed NO and N atoms.

40546 Interaction of trialkylaluminum reagents with metal-bound ethylene and carbon monoxide. The molecular structure of (eta^5-C_5Me_5)$_2$Ta(H)(C_2H_4xAlEt$_3$). McDade, C.; Gibson, V.C.; Santarsiero, B.D.; Bercaw, J.E. (California Institute of Technology, Pasadena (USA)). *Organometallics;* 7: No. 1, 1-7(Jan 1988). Contract FG03-85ER13431.

The compounds (eta^5-C_5Me_5)$_2$M(H)(C_2H_4) and (eta^5-C_5Me_5)$_2$M(H)(CO) (M = Nb, Ta) reversibly bind trialkylaluminum reagents to give 1:1 adducts in which the aluminum is bonded to the metal-bound ethylene or carbonyl oxygen in preference to the hydride ligand. The mixed-ring compound (eta^5-C_5Me_5)(eta^5-C_5H_5)Ta(H)(CO), in contrast, binds aluminum at the hydride ligand. The nature of the interactions has been established by IR and NMR studies and by determination of the molecular structure of (eta^5-C_5Me_5)$_2$Ta(H)(C_2H_4xAlEt$_3$) at reduced temperature [$P2_1/c$, a = 14.877 (5) A, b = 12.455 (7) A, c = 15.017 (4) A, β = 101.08 (13)°, V = 2730 (2) A^3, T = 220 K, Z = 4, 2496 reflections, S (goodness-of-fit) = 2.75, 283 parameters, R = 0.054 (2033 reflections, I > 3 σ/sub I/)]. This structure displays an unusual ethylene bridge between the aluminum and tantalum centers. The significance of these adducts in the context of Ziegler-Natta catalysis and migratory insertion is discussed.

40547 Spectroelectrochemical studies of electrochemically prepared poly-3-methylthiophene. Hoier, S.N.; Ginley, D.S.; Park, S.M. (Sandia National Labs., Albuquerque, NM (US)). *Journal of the Electrochemical Society;* 135: No. 1, 91-93(Jan 1988).

Electrochemically prepared poly-3-methylthiophene has been characterized employing spectroelectrochemical techniques. Results indicate that both oxidized and reduced forms of the polymer are stoichiometrically stable and the doping process is chemically reversible. The anodic doping level is between 0.12 — 0.19 as determined from spectroelectrochemical measurements, and several different functional groups appear to undergo redox reactions.

40548 Solid-state gallium-69 and gallium-71 nuclear magnetic resonance spectroscopic studies of gallium analogue zeolites and related systems. Timken, H.K.; Oldfield, E. (Univ. of Illinois, Urbana-Champaign (USA)). *Journal of the American Chemical Society;* **109**: No. 25, 7669-7673(9 Dec 1987). Contract AC02-76ER01198.

The authors have obtained solid-state 11.7-T ^{69}Ga and ^{71}Ga nuclear magnetic resonance (NMR) spectra of a series of gallosilicates (gallium analogues of zeolites Na-X, Na-Y, Na-sodalite, and Na-natrolite). From the apparent ^{69}Ga and ^{71}Ga chemical shifts, values of the nuclear quadrupole coupling constants (e^2qQ/h) and the true, isotropic chemical shifts (δ/sub i) have been deduced for the framework, tetrahedral, $Ga(OSi)_4$ sites. The e^2qQ/h values are in the range 1.9-2.7 MHz for ^{69}Ga and 1.2-1.7 MHz for ^{71}Ga. The isotropic chemical shifts are all in the range 171-186 ppm downfield from an external standard of 1 M $Ga(NO_3)_3$. Their results indicate that measurement of the apparent (second-order shifted) chemical shifts for pairs of isotopes of nonintegral spin quadrupolar nuclei in solids at one magnetic field strength is a useful new approach for determination of both isotropic chemical shifts and nuclear quadrupole coupling constant values.

40549 Ring size and strain as a control of reaction selectivity: ethylene sulfide on Mo(110). Roberts, J.T.; Friend, C.M. (Harvard Univ., Cambridge, MA (USA)). *Journal of the American Chemical Society;* **109**: No. 25, 7899-7900(9 Dec 1987). Contract FG02-84ER13289.

The adsorption and reaction of sulfur-containing organic on single-crystal transition-metal surfaces form a subject of current to the authors and others. The primary focus of their work is an investigation of how thermodynamic properties of adsorbate molecules affect the mechanism(s) by which they react. To this end, they have studied the reactions of two saturated cyclic sulfides-trimethylene sulfide ($c\text{-}C_3H_6S$) and tetrahydrothiophene ($c\text{-}C_4H_8S$)--on Mo(110). On the basis of these studies they proposed that ring strain in the cyclic sulfide controls reaction selectivity on Mo(110). This work concerns the reactions of a third cyclic sulfide, ethylene sulfide ($c\text{-}C_2H_4S$), on Mo(110). The results presented here demonstrate that ring size as well as ring strain determines the reaction selectivity of cyclic sulfides on Mo(110).

40550 Gas-phase coupling of methyl radicals during the catalytic partial oxidation of methane. Campbell, K.D.; Morales, E.; Lunsford, J.H. (Texas A & M Univ., College Station (USA)). *Journal of the American Chemical Society;* **109**: No. 25, 7900-7901(9 Dec 1987).

It is generally accepted that the initial step in the catalytic oxidative coupling of methane involves the homolytic cleavage of a C-H bond. This results in the formation of surface OH species and CH_3/sup ./ radicals which may undergo coupling to form ethane. A question arises as to whether the methyl radical coupling occurs on the surface or in the gas phase. Keller and Bhasin proposed a mechanism for the catalytic oxidative coupling of CH_4 in which the formation of C_2H_6 resulted from the surface coupling of adsorbed CH_3* radicals. In contrast to this mechanism, Lunsford and coworkers proposed that a homogeneous gas-phase coupling of CH_3* radicals, formed by the surface abstraction of H-atoms from CH_4, was the primary pathway for C_2H_6 formation. Evidence for the existence of gas-phase CH_3/sup ./ radicals during the oxidative coupling of CH_4 has been obtained by Driscoll et al. with the use of a matrix isolation electron spin resonance (MIESA) technique and, more recently, by Jones et al. with use of the Paneth lead mirror technique. The modeling studies of Labinger and Ott and of Kimble and Kolts also support the role of gas-phase CH_3/sup ./ radicals; however, the actual significance of these radicals in the formation of C_2H_6 has not been experimentally proven. In this communication of a lower limit for the rate of gas-phase CH_3* radical formation over a lithium-promoted MgO catalysts has been determined and this result is compared with the overall rate of C_2H_6 formation.

40551 Simulation of crystal structures by empirical atom-atom potentials. 1. The tetragonal-to-orthorhombic distortion in La_2CuO_4 and in the high-temperature superconductors La/sub 2-x/M/sub x/CuO_4 (M = Ba, Sr). Evain, M.; Whangbo, M.H.; Beno, M.A.; Geiser, U.; Williams, J.M. (North Carolina State Univ., Raleigh (USA)). *Journal of the American Chemical Society;* **109**: No. 25, 7917-7918(9 Dec 1987). Contract FG05-86ER45259;W-31-109-ENG-38.

A self-consistent, regioselective mechanism for the alkylnitrosurea (ANV) alkylation of DNA. The proposed mechanism is an attractive alternative to carbocation-like intermediates. Environmental mutagens and carcinogens may have similar mechanisms.

40552 Stereochemical course of methyl transfer from methanol to methyl coenzyme M in cell-free extracts of methanosarcina barkeri. Zydowsky, L.D.; Zydowsky, T.M.; Haas, E.S.; Brown, J.W.; Reeve, J.N.; Floss, H.G. (Ohio State Univ., Columbus (USA)). *Journal of the American Chemical Society;* **109**: No. 25, 7922-7923(9 Dec 1987). Contract AC02-81ER10945.

The transformation of the methyl group of methanol into methyl coenzyme M proceeds with net retention of methyl group configuration and without significant racemization. This is consistent with a proposed mechanism in which the methyl group is transferred from methanol first to the cobalt of the corrinoid enzyme MT_1 and then to the sulfur of coenzyme M. This resembles the transfer of the methyl group of methyltetrahydrofolate to homocysteine, catalyzed by the B_{12}-dependent methionine synthase from E. coli, which the authors have demonstrated also occurs with net retention of methyl group configuration. Both reactions pose the same question of how a relatively inert bond, the C-O bond of methyltetrahydrofolate in the case of methionine synthase, is cleaved in the transfer of a methyl group.

40553 Interface melting: simulations of surfaces and grain boundaries at high temperatures. Broughton, J.Q.; Gilmer, G.H. (State Univ., Stony Brook, NY (USA)). *Journal of Physical Chemistry;* **91**: No. 25, 6347-6359(3 Dec 1987). Contract FG02-85ER45218.

There is increasing experimental evidence for the existence of liquidlike layers on crystal surfaces and in grain boundaries, although the issue remains controversial. Recent simulations have provided definitive information on the equilibrium and dynamic properties of interfaces and clarify the conditions under which interface melting is to be expected.

40554 Electronic structure and spectra of 9-anthroic acid and its esters in supersonic free jets. Swayambunathan, V.; Lim, E.C. (Wayne State Univ., Detroit, MI (USA)). *Journal of Physical Chemistry;* **91**: No. 25, 6359-6364(3 Dec 1987).

The fluorescence excitation and dispersed fluorescence spectra of 9-anthroic acid, methyl 9-anthroate, and n-butyl 9-anthroate have been measured under supersonic jet expansion conditions. The fluorescence excitation spectra of the acid and its methyl ester show a long progression in a low-frequency mode that can be attributed to the torsional vibration of the carboxyl group. In all cases, the dispersed fluorescence spectrum is diffuse and greatly Stokes shifted relative to their absorption spectrum. These results are consistent with the perpendicular ground-state molecule (in which the plane of the carboxyl group is perpendicular to that of the anthracene ring) changing to a more coplanar form in the electronically excited state. The calculation of the torsional potential on methyl 9-anthroate indicates that the resonance stabilization is canceled by the steric repulsion even before complete coplanarity is achieved in the lowest excited singlet state of this molecule. The study also shows that 9-anthroic acid exists mainly in its hydrogen-bonded dimer form at nozzle temperatures of ~ 150°C. The probable structure of this dimer in the ground and electronically excited states is briefly discussed.

40555 2 + 1 REMPI spectra of cyclic ketones in a cold molecular beam. 1. Studies of the n → 3s Rydberg transition in unsubstituted rings. Cornish, T.J.; Baer, T. (Univ. of North Carolina, Chapel Hill (USA)). *Journal of the American Chemical Society;* **109**: No. 23, 6915-6920(11 Nov 1987).

The 2-photon excitation of the 3s Rydberg states in cyclopentanone, cyclohexanone, cycloheptanone, cyclooctanone, and norcamphor has been investigated by resonance enhanced multiphoton ionization (REMPI). A pulsed and seeded molecular beam of cold sample gas was crossed with a pulsed laser beam from an excimer pumped dye laser. Spectra in the region of 405-380 nm were obtained at sufficient resolution ($<1\ cm^{-1}$) to allow identification of some rotational contours. The C=O stretch and bending modes were identified on the basis of laser light polarization studies (linear versus circular) and by deuterium substitution. In all cases, the C=O stretching frequency was found to occur around 1250 cm^{-1} in the Rydberg spectrum which is significantly reduced from its ground-state counterpart. This reflects the increased C=O bond distance in the excited electronic state. A correlation between the origin of the $n \rightarrow 3s$ transition energy and the ground-state C-CO-C bond angle was found.

40556 **Critical test for resonance energies.** Randic, M.; Trinajstic, N. (Drake Univ., Des Moines, IA (USA)). *Journal of the American Chemical Society;* **109**: No. 23, 6923-6926(11 Nov 1987). Contract W-7405-ENG-82.

The concept of conjugated circuits is used to formulate minimal conditions for theoretical models which have been designed to provide molecular resonance energies of benzenoid hydrocarbons. More than 20 available schemes have been tested and more than half were found to be deficient with respect to inherent consistency of the derived parameters R/sub n/, signifying contributions from conjugated circuits of size $4n + 2$. The test is based on a graph-theoretical analysis which gives expressions for the molecular resonance energy and thus is independent of any computational errors or approximations in selection of the numerical parameters.

40557 **(UCRL-Trans—12223) Laser dyes, V: Synthesis of plane rigidized heptamethinecyanine dyes.** Heilig, G.; Luettke, W. Translated from *Chemische Berichte ;* **120**: 1863-1866(1987). Contract W-7405-ENG-48. 15p. Q/MF A01;1.

1,4,5,8,9,10-Hexahydro-2,7-dimethoxyanthracine (4) was synthesized from 2,7-dihydroxyanthraquinone (1) in a three-step synthesis. The individual synthesis steps can be performed in various ways. The pathway described here permits the convenient access to the product, gives the highest total yields and is also accessible on a larger scale (0.1 mol). The initiating methylation of 1 with dimethyl sulfate/KOH leads to the bismethyl ether (2) from which 4 can be synthesized by double reduction. 2 is first reduced with zinc in dilute ammonia to form an anthracene derivative which is then converted to the desired hydroanthracene 4 by Birch reduction with lithium. The total yield in this process is 76%. 12 refs., 1 fig., 2 tabs.

40558 **(LA-tr—88-9) Study in the behavior of several heavy elements in solvents with hydrofluoric acid base.** Tarnero, M. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France)). [1988]. Contract W-7405-ENG-36. Translation of CEA-R--3205, pp 49-70. 41p. NTIS, PC A03/MF A01;1.

Initial goal was the study of two nonaqueous solvents with an HF base, one with an oxidizing character, N_2O_4-HF, the other with an acid character, SbF_5-HF. For the N_2O_4-HF mixtures, nitric acid and NO_2^+ ions exist in these media, nitric acid is dissociated for concentrations of $N_2O^4 < 10$ Moles %, resulting in NO_2^+ ions. Results for the dissolution of metals agree with those of Brookhaven. For uranium, the speed did not increase in clear fashion from 60-70{degree}C, but that it obeyed Arrhenius' law between 40 and 115{degree}C. UF_4 was more soluble than ZrF_4. U(IV) passed to U(V) after dissolution. The compound obtained from UF_4 was the same as that obtained from the metal uranium, i.e., $NOUF_6$. U(VI)appeared to be poorly soluble, the uranium passes into solution particularly at valence 5. For SbF_5-HF mixtures, the corrosion speeds were much lower than in N_2O_4-HF mixtures. For Zr, rates of dissolution are very low, while they are very high with N_2O_4-HF. Th is practically not corroded at all. Al was not corroded at all up to 90{degree}C. Only U was dissolved at higher rates than Th and Zr; however, the corrosion speeds at 90{degree}C are equal to those with the N_2O_4-HF mixtures at 50{degree}C. This shows that U passed into solution in the trivalent state, and that the product was $U(SbF_6)_3$. The trivalent uranium compounds were more soluble than the others. Addition of N_2O_4 to SbF_5-HF induces acid-base reactions between the NO^+ and NO_2/sup {minus/} on the one hand, and SbF_6/sup {minus/} on the other hand, reactions accompanying the formation of a precipitate, probably a $NOSbF_6$ and NO_2SbF_6 mixture. 66 refs., 34 figs., 23 tabs.

4004 Electrochemistry

REFER ALSO TO CITATION(S) 40259, 40317, 40547

40559 **Carotenoid cation radicals: electrochemical, optical, and EPR study.** Grant, J.L.; Kramer, V.J.; Ding, R.; Kispert, L.D. (Univ. of Alabama, Tuscaloosa (USA)). *Journal of the American Chemical Society;* **110**: No. 7, 2151-2157(30 Mar 1988). Contract FG05-86ER13465.

The general aim of this investigation is to determine whether carotenoid cation radicals can be produced, and stabilized, electrochemically. Hence, the authors have undertaken a detailed study of the electrooxidation of various carotenoids (β-carotene (I), β-apo-8'-carotenal (II), and canthaxanthin (III) using the techniques of cyclic voltammetry, controlled-potential electrolysis (cpe) in conjunction with optical spectroscopy, and EPR spectroscopy coupled with in situ electrolysis. They report the successful generation of carotenoid cation radicals via electrochemical oxidation and, furthermore, the stabilization of these radicals for several minutes in CH_2Cl_2 and $C_2H_4Cl_2$ solvents.

4005 Photochemistry

REFER ALSO TO CITATION(S) 40534, 40555

40560 **(AD-A—190753/4/XAB) High-temperature photochemistry study of the D + ND_3 reaction.** Marshall, P.; Fontijn, A. (Rensselaer Polytechnic Inst., Troy, NY (USA). Dept. of Chemical and Environmental Engineering). 1987. 4p. (DAAL—03-87-K-0021). NTIS, PC A02/MF A01.

Jnl. of Physical Chemistry, Vol. 91, No. 24, 6297-6299(1987).

The kinetics of the D + ND_3 reaction was studied from 590 to 1220 K by using the high-temperature photochemistry (HTP) technique. D(12S) atoms were generated by flash photolysis of ND_3 and monitored by time-resolved atomic resonance fluorescence with pulse counting. K2(T) is determined to be exp(-8810 K/T) cc/molecule/s. Accuracy assessments are discussed in the text. Comparison to k1(T) for H + NH_3(1) measured in the same apparatus and over a similar temperature range shows that k2(T) is smaller. K1(T) and k2(T) agree reasonably well with calculations based on transition-state theory and a simple tunneling model using the same potential energy surface for both reactions. Considered alone, K2(T) can also be modeled without tunneling.

40561 **(PB—88-202478/XAB) Factors affecting the photochemical treatment of hazardous waste.** Zepp, R.G. (Environmental Protection Agency, Athens, GA (USA). Environmental Research Lab.). Apr 1988. 20p. (EPA—600/D-88/081). NTIS, PC A03/MF A01.

The photochemical treatment of hazardous waste can be optimized by taking into account several factors that influence the rates of photochemical reactions. Physical factors that facilitate photochemical treatment include: (1) maximizing the irradiated surface-to-volume ratio of the system, (2) selecting a light source with a spectrum that strongly overlaps the absorption spectrum of the chromophore, (3) vigorously mixing the reactants. Although hazardous wastes are degraded by the direct absorption of light, the overall rate of light-induced reactions can usually be accelerated by adding to the treatment system various dissolved or particulate substances that, upon light absorption, produce reactive excited states or free-radical intermediates that also react with the waste. Examples of such additives include ozone, peroxides, semiconducting metal oxides (such as titanium dioxide, and various organic photosensitizers that efficientiy photoproduce excited triplet states.

40562 Autoionization from the lone-pair orbitals of molecules containing iodine. Carlson, T.A.; Gerard, P.; Pullen, B.P.; Grimm, F.A. (Oak Ridge National Laboratory, Oak Ridge, Tennessee 37831-6201). *Journal of Chemical Physics;* 89: No. 3, 1464-1468(1 Aug 1988).

Autoionization to the lowest spin component of the ground state of the ion has been studied for the following alkyl iodides in the gas phase: CH_3I, C_2H_5I, and nC_3H_7I. Measurements have been made using the constant ionic state (CIS) method for photon energies between the ionization potentials arising from the spin—orbit split lone-pair orbitals of iodine. To carry out the measurements, angle resolved photoelectron spectrometry has been coupled with a variable photon source extracted from synchrotron radiation. A series of broad resonances together with some sharp resonances are seen for each study and the results for each molecule in the series show strong similarity to one another, illustrating the localized atom-like character of the lone-pair orbital. There are strong differences found in the extent of the background, which is attributed to the higher density of states for the longer carbon chains. Most measurements were taken for the ground state vibrational level, but results are also presented for ionization to the ν_2 excited vibrational state of CH_3I^+. New resonances, not seen for the ground vibrational state, are found and their origin discussed. CIS spectra on the I_2 molecule are reported, which are in strong contrast to the alkyl iodides. Possible reasons for the differences are presented.

40563 Laser flash photolysis study of photochemical carbonyl substitution in $M(CO)_6$ (M = Cr, Mo, W) with 1,10-phenanthroline. Oishi, S. (Univ. of Notre Dame, IN (USA)). *Organometallics;* 7: No. 6, 1237-1241(Jun 1988).

Photoreactions of $M(CO)_6$ (M = Cr, Mo, W) with 1,10-phenanthroline (phen) have been investigated by laser flash photolysis. A transient spectrum due to $Cr(CO)_5$(phen), where phen ligates in a monodentate fashion, was observed. In the cases of Mo and W, the growth curve of the final product, $Mo(CO)_4$(phen), was found to accord with the kinetics of consecutive first-order reactions. These facts indicate that, even with a ligand as well-suited to bidentate bonding as phen, the coordination of $M(CO)_5$ to phen does not concert with the extrusion of the second carbonyl. Both these reactions, however, were found to be significantly accelerated compared with those for pyridine derivatives, suggesting a profound electronic interaction between the metal atom and the noncoordinated nitrogen in $M(CO)_5$(phen). The wavelength shift of the d-d band in $Cr(CO)_5$(phen) is also attributable to this interaction. However, at this stage, it cannot be concluded whether the interaction is coordination, that is, whether $M(CO)_5$(phen) can be considered as the 7-coordinate 20-electron complex of an associative substitution mechanism.

40564 Cis and trans olefin radicals: equilibrium and photoisomerization. Ebbesen, T.W.; Akaba, R.; Tokumaru, K.; Washio, M.; Tagawa, S.; Tabata, Y. (Univ. of Notre Dame, IN (USA)). *Journal of the American Chemical Society;* 110: No. 7, 2147-2151(30 Mar 1988).

Electrochemical reduction of 1,2-bis(1-methyl-4-pyridino)ethylene dication gives the same reduction potentials (-0.53 and -0.72 V vs SCE in CH_3CN) for both cis and trans isomers. Only the absorbance spectrum of the trans radical (epsilon(max) 57,000 M^{-1} cm^{-1} at 517 nm) is observed. However, by using pulse radiolysis the radicals of both cis and trans isomers are observed in aqueous solution. Although their absorbance spectra are similar, the extinction coefficients are very different. The cis radical is intrinsically stable but undergoes rapid electron exchange with the trans dication isomer. Cis and trans radicals equilibrate through electron exchange, the limiting rate constants in both directions of the equilibrium being 2×10^9 M^{-1} s^{-1} (cis to trans) and 3×10^8 M^{-1} s^{-1} (trans to cis). The photoisomerization of the olefin radicals is essentially one-ray: the quantum yield for the cis radical is 0.2, while that of the trans is less than 0.01.

40565 Transition-metal-mediated photochemical disporportionation of carbon dioxide. Belmore, K.A.; Vanderpool, R.A.; Tsai, J.C.; Khan, M.A.; Nicholas, K.M. (Univ. of Oklahoma, Norman (USA)). *Journal of the American Chemical Society;* 110: No. 6, 2004-2005(16 Mar 1988).

Efforts to activate carbon dioxide by transition-metal complexes have centered primarily on its organometallic chemistry and transition-metal-mediated electrochemistry and, to a limited extent, on metal-mediated photochemical reduction. A common feature of coordinated CO_2 reactivity emerging from studies of its interaction with electron-rich metal complexes is O-atom transfer, most commonly manifested as reductive disproportionation. In a few instances O-transfer to a substrate other than CO_2 has been observed such as to oxophilic metals, isocyanides, or phosphines, the latter catalytically. In an effort to expand the scope of these reactions and to overcome their thermodynamic limitations, the authors are seeking complexes which could mediate CO_2 splitting photochemically. It appeared that the molybdenocene system (L/sub n/M = Cp_2Mo) might be a suitable one for this purpose since not only are several anticipated intermediates known, i.e., Cp_2Mo, Cp_2MoO, Cp_2MoCO, and $CpMo(CO_2)$, but CpMoL/sub 1,2/ complexes in general appear to be photochemically active toward M-L scission. Resulting from their initial investigations of the molybdenocene-CO_2 system, they provide here the first example of photoinduced disproportionation of coordinated carbon dioxide.

40566 Laser-ion beam photodissociation studies of ionic cluster fragments of transition-metal carbonyls. Tecklenburg, R.E. Jr.; Russell, D.H. (Texas A & M Univ., College Station (USA)). *Journal of the American Chemical Society;* 109: No. 25, 7654-7662(9 Dec 1987). Contract AS05-82ER13023.

Ionic cluster fragments of the type M/sub x/(CO)/sub y/$^+$ are studied by laser-ion beam photodissociation. The systems studied include Mn/sub x/(CO)/sub y/$^+$ (x = 1-2; y = 0-10, derived from $Mn_2(CO)_{10}$), Fe/sub x/(CO)/sub y/$^+$ (x = 3; y = 5-12, derived from $Fe_3(CO)_{12}$), and Co/sub x/(CO)/sub y/$^+$ (x = 2-4; y = 0-12, derived from $Co_4(CO)_{12}$). Relative photodissociation cross sections for each ion and upper limits to bond dissociation energies for M-M and M-Co are reported. Average metal-metal bond energies for the Mn_2(CO)/sub y/$^+$ and Co_4(CO)/sub y/$^+$ ions are found to be < 44 and 16 kcal/mol, respectively. M-M bond energies could not be determined for Fe_3(CO)/sub y/$^+$ ions because photodissociation of this system is dominated by expulsion of the CO ligand. Upper limits for metal-ligand bond energies are < 25, 24, and 23 kcal/mol for Mn_2(CO)sub y/$^+$, Fe_3(CO)/sub y/$^+$, and Co_4(CO)/sub y/$^+$ systems, respectively.

40567 Infrared multiphoton-induced isomerization of tetrafluorocyclopropene. Friedrich, H.B.; Burton, D.J.; Tardy, D.C. (Univ. of Iowa, Iowa City (USA)). *Journal of Physical Chemistry;* 91: No. 25, 6334-6336(3 Dec 1987). Contract FG02-87ER13700.

Infrared multiphoton excitation of tetrafluorocyclopropene (TFCP) leads to the unexpected formation of tetrafluoroallene (TFA) and tetrafluoropropyne (TFP). The ratio of TFP to TFA formed in the reaction is independent of fluence and pressure, and no other products are formed. The conversion per pulse increases as the pressure of TFCP increases but decreases as the pressure of a buffer gas or the products increases. The apparent intramolecular 1,2-fluorine migration required to form the products is discussed in terms of both unimolecular and bimolecular processes.

40568 Photochemistry of 3,4,9,10-perylenetetracarboxylic dianhydride dyes. 3. Singlet and triplet excited-state properties of the bis(2,5-di-tert-butylphenyl)imide derivative. Ford, W.E.; Kamat, P.V. (Univ. of Notre Dame, IN (USA)). *Journal of Physical Chemistry;* 91: No. 25, 6373-6380(3 Dec 1987).

Fluorescence lifetime and triplet-state spectral, kinetic, and energetic properties are reported for the first time for a perylenebis(dicarboximide) dye, N,N'-bis(2,5-di-tert-butylphenyl)-3,4,9,10-perylenebis(dicarboximide) (DBPI). The fluorescence lifetime (3.8 +/- 0.2 ns), quantum yield (≧ 0.95), and singlet-state energy (54 +/- 1 kcal mol^{-1}) were determined for DBPI in a variety of organic solvents (24°C). Triplet sensitization was used to characterize the triplet state of DBPI by laser flash photolysis and pulse radiolysis. The triplet-triplet absorption spectrum of DBPI had a maximum in the range 495-505 nm with an extinction coefficient of (6.3 +/- 0.7) x 10^4 M^{-1} cm^{-1}, and the triplet-state energy and lifetime were 27.5 +/- 2 kcal mol^{-1} and ≈ 100 μs, respectively. Direct photoexcitation produced the DBPA triplet with very

low quantum yields (<0.001). Excimerlike fluorescence spectral and lifetime data for DBPI in the solid state are also presented.

40569 Photochemical dehydrofragmentation reactions: importance of donor and acceptor structure in determination of reactivity in radical ion pairs formed in electron-transfer photoreactions. Ci, X.; Whitten, D.G. (Univ. of Rochester, NY (USA)). *Journal of the American Chemical Society;* **109**: No. 23, 7215-7217(11 Nov 1987). Contract FG02-86ER13504.

Photoinduced electron-transfer reactions are the subject of considerable interest due both to the versatility of net chemical reactions which can be achieved as well as to the variety of intermediates and mechanistic complexities encountered in their study. For initially neutral donors and acceptors quenching of excited singlet states is frequently dominated by formation of a geminate ion pair, A^-/D^+, which can subsequently decay by back electron transfer or, in moderately polar to polar solvents, by cage escape to form free ions. In nonpolar solvents the back electron transfer process acts as an effective clock to limit the lifetime for reaction of the geminate pair to the ns time; consequently only relatively rapid reactions can occur efficiently from the geminate pair and these frequently involve participation of the solvent or other reagents present in high concentration. The authors have previously reported the chemically clean and moderately efficient C-C bond photofragmentation reactions of β-amino-alcohols initiated by electron transfer to excited acceptors. They report here a mechanistic study where this reaction is restricted to the geminate pair and which emphasizes the complimentary roles of reduced acceptor and oxidized donor in facilitating chemical reaction in competition with fast back electron transfer. A key result is that rapid fragmentation is coincident with acceptor radical anion induced deprotonation of the donor cation radical and thus strongly dependent on acceptor structure.

40570 Experiments in soft x-ray near-field diffraction imaging with an undulator. Jacobsen, C.; Kirz, J.; Howells, M.R.; Sayre, F.D. (SUNY-Stony Brook, Physics Dept., Stony Brook, NY 11794-3800 (US)). pp 160 of XV international conference on quantum electronics (Digest of technical papers). Washington, DC; Optical Society of America (1987). (CONF-870488—).

From 15. international conference on quantum electronics; Baltimore, MD, USA (27 Apr 1987).

Technical Paper THGG 37.

Experiments in soft x-ray near-field diffraction imaging and holography have been carried out with 25- and 36-A undulator radiation at the National Synchrotron Light Source at Brookhaven National Laboratory. By using a near-field version of the Gabor hologram geometry, the authors are attempting to capitalize on the high spatial resolution offered by PMMA and a copolymer of PMMA/MAA photoresist detectors. They plan to numerically reconstruct the image from a high-resolution map of the detected exposure level made by electron microscopy or some other means. The authors are considering reconstruction either along the lines of classical holography or by phasing the diffraction field through use of the multiple near-field recordings.

4006 Radiation Chemistry

REFER ALSO TO CITATION(S) 39434, 39650, 40444, 40535, 40564, 42111

40571 (INIS-mf—11697) Investigations into the OH-induced strandbreak of poly(C) in aqueous solutions. An experimental study on the state of saltfree poly(C) solutions and the influence of the chain cleavage on the coefficient of conductivity. Mueller, M. (Bochum Univ. (Germany, F.R.). Abt. fuer Chemie). 26 Apr 1983. 185p. (In German). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88753804/JAW.

Schriftenreihe des Max-Planck-Instituts fuer Strahlenchemie.; no. 9.

The author has investigated the formation of OH-induced strandbreaks in poly(C) employing i) a small angle light scattering method for determining molecular weights and ii) a conductivity method for following the kinetics and the amount of chain splittings after a 2 μs electron pulse. The G-value of single stranded chain splitting in poly(C) in N_2O-saturated solutions around pH 7 is found to be 2.1, independent of the ionic strength and temperature. This value is much higher than the G-value (= 0.55) obtained in case of DNA. The rate of the conductivity increase after pulse-absorption in N_2O-saturated solutions obeys a first order rate law. Experiments with radical scavengers such as para Benzoquinone (p-BQ) and Dithioerethritol (DTT) show, that the rate determining step of the conductivity increase of single stranded Poly(C) is the cleavage of the chain. The change of the observed kinetics on increasing the pH has been analysed and by extrapolation the uncatalysed rate constant for the chain splitting is calculated to be in the range of $k \approx 0.2\ s^{-1}$. The rate constant at pH $\approx$ 7 in salt free solutions however is about 20 s^{-1}, supporting the assumption of significant intramolecular proton catalysis. (orig.RB)

40572 (RISO-M—2688) Kinetics and mechanisms of elementary chemical processes of importance in combustion. Munk, J.; Pagsberg, P.; Ratajczak, E.; Sztuba, B.; Sillesen, A. (Risoe National Lab., Roskilde (Denmark)). Jan 1988. 54p. NTIS (US Sales Only), PC A04/MF A01 - Risoe Library, DK-4000 Roskilde. Order Number DE88753656/JAW.

The technique of pulse radiolysis combined with transient ultraviolet absorption spectrophotometry has been employed in spectrokinetic studies of shortlived free radical intermediates of importance in combustion. Various source reactions for vinyl, propargyl and carboxyl radicals have been investigated and the UV-spectra of these radicals have been recorded. The spectral features have been utilized in kinetic studies of the self-reactions of the radicals and the reactions with oxygen. Kinetic results on the reaction NO + NH_2 are also reported. 10 refs.

40573 X-ray absorption of Azotobacter vinelandii vanadium nitrogenase. George, G.N.; Coyle, C.L.; Hales, B.J.; Cramer, S.P. (Exxon Research and Engineering Company, Annandale, NJ (USA)). *Journal of the American Chemical Society;* **110**: No. 12, 4057-4059(8 Jun 1988).

Evidence for the existence of a vanadium-containing nitrogenase has existed for more than half a century, but progress in understanding this enzyme has only come recently. In 1980, Bishop and co-workers proposed that an alternative nitrogen-fixing enzyme exists in Azotobacter vinelandii and subsequently proposed that vanadium was involved. In 1986, Robson et al. demonstrated clearly that the alternate nitrogenase from Azotobacter chroococcum, Acl*, contained vanadium instead of molybdenum. Hales et al. have shown the vanadium is also found in the Azotobacter vinelandii alternative component I, Avl'. The molybdenum and vanadium nitrogenase proteins are similar in many respects. Like the molybdenum enzyme, both Acl* and Avl' exhibit an EPR spectrum characteristic of a species with an S = 3/2 ground state; Avl' also contains the so-called P-clusters. Additionally Acl* has recently been shown to possess an N-methylformamide soluble cofactor, FeVco, analogous to the well-known iron-molybdenum cofactor FeMoco. Arber et al. have reported X-ray absorption spectra for the Acl* enzyme and interpreted the EXAFS as evidence for a V-Fe-S cluster. The local vanadium structure is proposed to resemble a recently synthesized cubane-like VFe_3S_4 cluster, and analogies are drawn with the EXAFS-derived structure reported for the molybdenum nitrogenases. The authors report herein an X-ray absorption spectroscopic study of A. vinelandii vanadium nitrogenase, Avl', which supports and extends the work of Arber et al.

40574 Studies of hypervalent iron in aqueous solutions. 1. Radiation-induced reduction of iron(VI) to iron(V) by CO_2p. Bielski, B.H.J.; Thomas, M.J. (Brookhaven National Lab., Upton, NY (USA)). *Journal of the American Chemical Society;* **109**: No. 25, 7761-7764(9 Dec 1987). Contract AC02-76CH00016.

Iron(VI) can be reduced in aqueous solutions to iron(V) by pulse radiolytically generated CO_2^-, $k_3 = (3.5 +/- 0.1) \times 10^8\ M^{-1}\ s^{-1}$. The respective UV and visible spectra for these hypervalent oxidation states or iron are reported. It was found that formate reacts 10^5 times faster with Fe(V) than with Fe(VI). Other kinetic rate measurements include the following: $k_4[O_2^- + Fe(VI)] = (5.71 +/- 0.17) \times 10^3$, k[NADA + Fe(VI)] = 77.1 +/- 4.4,

k[HCOONa + Fe(VI)] = (2.33 +/- 0.4) x 10^{-2}, k[EtOH + Fe(VI)] = (1.47 +/- 0.7) x 10^{-3}, k[DPTA + Fe(VI)] = (8.53 +/- 0.32) x 10^{-4}, k[HCOONa + Fe(V)] = (2.48 +/- 0.32) x 10^{3} M^{-1} s^{-1}. The results are discussed in terms of their possible role in Fe(VI) oxidation processes.

4007 Radiochemistry And Nuclear Chemistry

REFER ALSO TO CITATION(S) 39252, 39281, 39295, 41447, 41472

40575 (CEA-CONF—9212) Crystal structure of UCp3Cl by neutron diffraction. Delapalme, A.; Schweiss, P.; Spirlet, M.R.; Rebizant, J.; Kanellakopulos, B. (Laboratoire Leon Brillouin, Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France)). Aug 1987. 5p. (CONF-8708117—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88752561/JAW.

From Neutron scattering symposium on advances and applications; Sydney, Australia (8 Aug 1987).

The structure of uranium chloride π-tricyclopentadienyl UC/sub p3/Cl contains both U-Cl σ-bonds and U-Cp π-bonds and thus represents a very interesting system to study in detail possible covalency of these bonds. We have therefore performed a neutron experiment to complement previous X-ray experiments, since the latter are not very sensitive to the C and H atoms in the presence of uranium. A low resolution model showed that a disorder model of Cp rings is necessary. The disorder of the Cp rings as viewed by the neutron diffraction is of a simple form with only two possibilities, ABC and A'B'C' rotated by 36 deg. Space considerations show that the arrangements of all three Cp rings, around one particular U atom must be of the same form (ABC or A'B'C'); R/sub w/=6%; chi {similar←to}1.5. At temperatures between 80 and 100 K, we have discovered a crystallographic phase transition in UC/sub p3/Cl. We have not fully characterized this yet since it results in a large deformation of the crystal, presumably due to internal strains. The transition leaves unchanged the crystallographic parameters of the uranium and chlorine atoms and of the centers of the Cp rings, the transition is probably an ordering of the Cp rings as it is not observed in magnetic susceptibility measurements.

40576 (DOE/ER/60434—3) Synthesis of radiopharmaceuticals containing short-lived radionuclides: Comprehensive progress report, March 1, 1986-February 28, 1989. Kabalka, G.W. (Tennessee Univ., Knoxville (USA). Dept. of Chemistry). Jun 1988. Contract FG05-86ER60434. 25p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88011524/JAW.

The primary objective of the DOE Nuclear Medicine Program at The University of Tennessee is the creation of new methods for intoducing short-lived isotopes into agents for use in PET and SPECT. A portion of our effort is directed toward the design and in vivo quantitation of boron-containing neutron therapy agents. The uniqueness of the program is its focus on the design of new chemistry (molecular architecture) and technology as opposed to the application of known reactions to the synthesis of specific radiopharmaceuticals. The following topics are outlined in this paper: new isotope incorporation reactions utilizing nitrogen 13, oxygen 15, and carbon 11; technetium-boron complexes; boron-neutron-capture.

40577 (DOE-RW—88.34) Application of Moessbauer spectroscopy to the study of neptunium adsorbed on deep-sea sediments. Bennett, B.A.; Rees, L.V.C. (Imperial Coll. of Science and Technology, London (UK). Dept. of Chemistry). (Department of the Environment, London (UK)). Mar 1987. 52p. NTIS (US Sales Only), PC A04/MF A01. Order Number DE88754098/JAW.

A Neptunium Moessbauer spectrometer (the first in Great Britain) was constructed and the Moessbauer spectra of NpAl Laves phase alloy obtained. Neptunium was sorbed onto a calcareous deep-sea sediment from sea water, using a successive-loading technique. Sorption appeared to be by an equilibrium reaction, and because of the low solubility of neptunium in seawater, this meant that the maximum loading that could be achieved was 8mg/sup 237/Np/g sediment. This proved to be an adequate concentration for Moessbauer measurements and a Moessbauer spectrum was obtained. This showed that most of the neptunium was in exchange sites and not present as precipitates of neptunium compounds. It was probably in the 4+ state indicating that reduction had occurred during sorption. This work has demonstrated that Moessbauer Spectroscopy has great potential as an aid to understanding the mechanism of actinide sorption in natural systems.

40578 (INIS-mf—11196) Preparation of 19-iodocholestrol labelled with I-125 and its study as a 'tracer' of plasma lipoprotein. Rodriquez Barquero, L. (Universidad de Alcala de Henares, Madrid (Spain). Facultad de Ciencias Quimicas). 1988. 185p. (In Spanish). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88703051/JAW.

A technique of synthesis of the 19-iodocholesterol labelled with I-125, modified in some steps from other methods published previously, is described. We have obtained a product with high chemical (96%) and radiochemical (99,9%) purities. The yield was higher and the time necessary to prepare it was lower than other methods reported. The study of thermal and, radiolytic stability showed that the 19-iodocholesterol-I-125 was not broken by autoradiolysis whereas the I-125 was separated from the molecule when the temperature was increased. The use of this 19-iodocholesterol-I-125 as a tracer of cholesterol of plasma lipoprotein showed some properties of LCAT and CETP and also showed the different capacity of VLDL and LDL to transport cholesteryl esters. (author) 105 refs.

40579 (INIS-mf—11212) Preparation of Sb/sub 2/S/sub 3/-/sup 99m/Tc radiocolloid for the use in lymphoscintography. Granados Correa, Francisco. (Universidad Autonoma del Estado de Mexico, Toluca. Escuela de Ciencias Quimicas). 1987. 72p. (In Spanish). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88703256/JAW.

A series of investigations carried out to obtain a radiocolloid with physical, chemical and pharmaceutical properties appropriate for use in lymphoscintography are described. Variables which affect the safety and efficacy of the radioactive drug were studied, such as the concentrations of the ligand and of the reducing agent, as well as the Tc-99m-labelling efficiency. To determine the best labelling conditions, the effects of temperature, incubation time and the influence of the concentration of the radioactive tracer on the in vitro stability of the product were investigated. Similary, the stability of the product four hours after labelling was observed. The size and shape of the particles were measured by electron microscopy. Biodistribution and toxicity studies were carried out in white Balb C mice. An orange solution of colloidal Sb/sub 2/S/sub 3/ labelled with Tc-99 was obtained, which was labelled with 95% efficiency. The particles were negatively charged and had a particle size between 5 and 50 nm. The animal biodistribution studies showed that the lymph nodes selectively take up the radiopharmaceutical with satisfactory efficiency. The product is sterile, pyrogen free and not toxic.

40580 (JINR—R-7-86-322, pp 27) Selective extraction of transplutonium and rare earth elements by trioctylphosphine oxide. Gorski, B.; Korotkin, Yu.S. 1986. (In Russian). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88780065/JAW.

In Heavy ion physics - 1985. Collection of annotations of the Nuclear Reaction Laboratory of the Joint Nuclear Research Institute works, 1985.

40581 (JINR—R-7-86-322, pp 17) Search of products of fusion reactions /sup 235/U + /sup (sup 4)0/Ar and /sup 232/Th + /sup 37/Cl. Chepigin, V.I.; Kharitonov, Yu.P.; Gorski, B. 1986. (In Russian). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88780065/JAW.

In Heavy ion physics - 1985. Collection of annotations of the Nuclear Reaction Laboratory of the Joint Nuclear Research Institute works, 1985.

40582 **(JINR-R—12-87-684) Microviscosity of ions and salting-out in solvent extraction of rare earths and transplutonium elements by various extractants.** Gorski, B.; Gorskij, N.I.; Vinde, K. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Reactions). 1987. 4p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88703419/JAW.

Submitted to the Organizing Comittee of International conference on liquid extraction, Moscow, 27 Jun - 3 Jul 1988.

The use of microviscosity (the viscosity of the first hydration shell of ions) for the description of salting-out effect in extraction systems has been investigated. The dependences of solvent extraction of rare earths and transplutonium elements with trioctylphosphine oxide and aliquat 336 on the microviscosity of various ions as salting-out agents have been determined. The results indicate that it is possible to use the microviscosity for the explanation of saltin-out action of cations. 5 refs.; 3 figs; 2 tabs.

40583 **(MLM—3513(OP)) Ammonia in tritium systems.** Gill, J.T.; Ellefson, R.E.; Paulick, R.P.; Colvin, C.M.; Yauger, R.L.; Johns, E.E.; Anderson, R.L.; Lewis, E.L.; Lamberger, P.H.; Vallee, R.E. (Monsanto Research Corp., Miamisburg, OH (USA). Mound). 1988. Contract AC04-76DP00053. 8p. (CONF-880505—37). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88012875/JAW.

From 3. topical meeting on tritium technology in fission, fusion and isotopic applications; Toronto, Canada (1 May 1988).

A recent tritium inventory imbalance at Mound required an investigation into its causes. Much tritium was found as HTO in unsuspected zeolite traps of a T-purification system. Isotopic exchange from ammonia was postulated as a mechanism for entry of T into the zeolitic water. Gases from a T-processing system which had experienced air in-leakage were shown, by trapping of condensibles, to contain substantial H-isotopic waters and ammonias. Further evidence for tritiated ammonia was inferred from changes in pressure and T purity in otherwise unperturbed tanks of N_2 and $(H/D/T)_2$. From two such tanks which held N_2 and T_2 at equilbrium, ammonia was trapped and decomposed. 15 refs., 7 figs., 1 tab.

40584 **(NAS-NS—3019-Rev.) Radiochemistry of carbon, nitrogen and oxygen.** Sajjad, M.; Lambrecht, R.M. (King Faisal Specialist Hospital and Research Centre, Riyadh (Saudi Arabia). Radionuclide and Cyclotron Operations Dept.). 1988. 88p. NTIS, PC A05/MF A01;1; GPO Dep. Order Number DE88007751/JAW.

The present monograph consists of two reviews. The first section deals with radiopharmaceutical and biomedical applications. The second section deals with analysis of carbon, nitrogen and oxygen in different materials by use of nuclear techniques. This monograph is published as part of our continuing effort to update, revise, and expand the previously published monographs to keep them current and relevant. 158 refs., 4 figs., 12 tabs.

40585 **Syntheses of 5'-deoxy-5-[^{18}F]fluorouridine and related compounds as probes for measuring tissue proliferation in vivo.** Shiue, C.Y.; Wolf, A.P.; Friedkin, M. (Brookhaven National Lab., Upton, NY (USA)). *Journal of Labelled Compounds and Radiopharmaceuticals;* **21**: No. 9, 865-873(14 May 1984).

A rapid synthesis of 5'-deoxy-5-[^{18}F]fluorouridine (3a) from either [^{18}F]F_2 of CH_3CO_2 ^{18}F is described. Fluorination of 2',3'-di-O-acetyl-5'-deoxyuridine (1a) with either [^{18}F]F_2 or CH_3CO_2 ^{18}F in glacial acetic acid at room temperature followed by hydrolysis with sodium methoxide in methanol gives 5'-deoxy-5-[^{18}F]fluorouridine (3a) in radiochemical yields of 20-25% in a synthesis time of 80 min from EOB. The same method also has been used to synthesize 5-[^{18}F]fluorouridine (3b) and 2'deoxy-5-[^{18}F]fluorouridine (3c) in similar radiochemical yields. Acetyl hypofluorite (CH_3CO_2F) is proposed as an intermediate for these reactions.

4008 Combustion, Pyrolysis, And High-temperature Chemistry

REFER ALSO TO CITATION(S) 40360, 40538, 40539, 40718, 41128, 41129

40586 **(AD-A—189114/2/XAB) Fuels-combustion research. Final report, 1 August 1986-31 July 1987.** Dryer, F.L.; Glassman, I.; Williams, F.A. (Princeton Univ., NJ (USA). Dept. of Mechanical and Aerospace Engineering). 8 Oct 1987. 16p. NTIS, PC A03/MF A01.

The DOD URIP equipment grant received by the Fuels Combustion Research Group was used, in accord with the original intent of the award, to update an advance the analytic capabilities of the combustion laboratories. The newly purchased gas- and liquid-chromatographic instrumentation became the center pieces of a DOD-supported analytic facility recently shown to the Chairman of the Joint Chiefs of Staff, Admiral William J. Crowe, Jr. as an example of DOD-supported research in the School of Engineering. The chemical-analysis instrumentation in the facility as well as the boron-particle sizing and visualizing devices are described briefly. Photographs of the installed equipment are used to facilitate the description of the various pieces of instrumentation.

40587 **(AD-A—189615/8/XAB) Soot oxidation kinetics. Final report, 1 August 1983-15 December 1987.** Felder, W. (Aerochem Research Labs., Inc., Princeton, NJ (USA)). Dec 1987. 12p. (AEROCHEM-TP—471). NTIS, PC A03/MF A01.

Soot and carbon-black oxidation kinetics were measured under controlled temperature, pressure, and oxygen concentration, conditions in a modified High-Temperature Fast-Flow Reactor. The kinetic measurements are carried out under conditions where the carbon particle consumption rate is controlled by gas-particle interactions and not by mass transfer. Auxiliary surface-area measurements on partially oxidized particles collected from the HTFFR indicate that the oxidation is controlled by external-surface rather than pore-centered reactions. The measured particle reactivities (g cm^{-2} s^{-1}) are x 10 smaller than predicted by the often-used Nagle-Strickland-Constable semi-empirical model for carbon oxidation nor do the O_2 dependences conform to this model. Additional work is required to elucidate the reasons for this disparity.

40588 **(AD-A—191575/0/XAB) Radiography of liquid-metal-fuel combustion. Professional paper for period ending August 1987.** Parnell, L.A.; Katz, D.L.; Gilchrist, J.T.; Bryant, L.E.; Lucero, J.P. (Naval Ocean Systems Center, San Diego, CA (USA)). Jan 1988. 7p. NTIS, PC A02/MF A01.

Liquid-metal fuels are being employed as Rankine-cycle heat sources for undersea vehicle propulsion systems, necessitating investigation of the fundamental chemical, thermodynamic, and hydrodynamic processes that occur during the confined combustion of these fuels. Results of the development of techniques for this use of flash x-ray radiography to investigate these processes is presented. Experimental combustors designed to permit studies of the combustion zone and fluid dynamics of the jet-driven circulating flow in the fuel bath are described. Radiographic images showing the reaction zone, multiphase flow structures and the behavior and mixing characteristics of the products-rich phase are shown, demonstrating the utility of this experimental techniques in energy-conversion research.

40589 **(AD-A—191590/9/XAB) RTR studies of closed combustion of liquid-metal fuels. Professional paper for period ending June 1987.** Parnell, L.A.; Edmunds, D.G.; Rogerson, D.J. (Naval Ocean Systems Center, San Diego, CA (USA)). Jan 1988. 7p. NTIS, PC A02/MF A01.

The use of liquid-metal combustion as a Rankine cycle heat source in stored-chemical-energy propulsion systems for undersea vehicles has fostered interest in the fundamental processes occurring during such combustion. This paper reports an investigation into the use of high energy, real-time radiography to provide x-ray images of the confined combustion of an oxidant injected and submerged in a fuel bath. Studies of the combustion processes and fluid

dynamics of the jet driven circulating flow in the fuel bath are described. Results of tests using cylindrical combustors that have single, horizontal oxidizer jets at their centerlines are presented. Selected radiographic images showing some of the large-scale, low-frequency turbulence, dense product behavior and reaction zone growth that occurs during such closed combustion processes are presented and discussed.

40590 **(CONF-880567—7) Computational combustion chemistry on an FPS/164.** Harding, L.B. (Argonne National Lab., IL (USA)). 1988. Contract W-31109-ENG-38. 8p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE88010025/JAW.

From 3. international conference on supercomputing; Boston, MA, USA (15 May 1988).

Computational Chemistry is playing an increasingly important role in elucidating the detailed mechanisms of combustion. In this paper examples are presented which illustrate how a detailed knowledge of potential surfaces for combustion reactions, obtained from large scale quantum chemistry calculations, can be used to predict rate constants in regimes not currently accessible to experiment. 14 refs., 3 figs.

40591 **(N—88-19377) Study of industry requirements that can be fulfilled by combustion experimentation aboard space station. Final contractor report.** Priem, R.J. (Priem Consultants, Inc., Cleveland, OH (USA)). Mar 1988. 62p. (NASA-CR—180854; E—3901; NAS—1.26:180854). NTIS, PC A04/MF A01.

The purpose of this study is to define the requirements of commercially motivated microgravity combustion experiments and the optimal way for space station to accommodate these requirements. Representatives of commercial organizations, universities and government agencies were contacted. Interest in and needs for microgravity combustion studies are identified for commercial/industrial groups involved in fire safety with terrestrial applications, fire safety with space applications, propulsion and power, industrial burners, or pollution control. From these interests and needs experiments involving: (1) no flow with solid or liquid fuels; (2) homogeneous mixtures of fuel and air; (3) low flow with solid or liquid fuels; (4) low flow with gaseous fuel; (5) high pressure combustion; and (6) special burner systems are described and space station resource requirements for each type of experiment provided. Critical technologies involving the creation of a laboratory environment and methods for combining experimental needs into one experiment in order to obtain effective use of space station are discussed. Diagnostic techniques for monitoring combustion process parameters are identified.

40592 **(SAND—87-3029C) Preliminary burn rate studies on TiH/sub 1.65//KC10$_4$.** Hingorani-Norenberg, S.L.; Moore, L.M. (Sandia National Labs., Albuquerque, NM (USA)). 1988. Contract AC04-76DP00789. 15p. (CONF-880750—8). NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88011546/JAW.

From 13. international pyrotechnics seminar; Grand Junction, CO, USA (11 Jul 1988).

With a long-term goal of characterizing the burn-rate bahavior of several energetic materials, a series of experiments has been conducted to study the burn-rate behavior of titanium subhydride potassium perchlorate (TiH/sub 1.65//KC10$_4$). The current research investigates the variation of the burn rate of this material with increasing bulk density in a zero-free-volume closed bomb. Thus far the results indicate that the burn rate increases with increasing bulk density to a certain maximum, and then decreases with any additional increase in density. This dependence of burn rate on density is discussed in terms of conductive and convective burning. 12 refs., 6 figs.

40593 **(SAND—88-7097C) Transient burning analysis of pyrotechnic materials in a closed bomb.** Razani, A.; Shahinpoor, M. (Sandia National Labs., Albuquerque, NM (USA); New Mexico Univ., Albuquerque (USA). Dept. of Mechanical Engineering). 1988. Contract AC04-76DP00789. 17p. (CONF-880750—9). NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88011794/JAW.

From 13. international pyrotechnics seminar; Grand Junction, CO, USA (11 Jul 1988).

The transient mass burning rate of energetic materials in a conductive mode can be calculated from the single pressure-time record of a closed bomb experiment. Assuming negligible heat loss and no initial gas in the bomb, the mass burning rate of pyrotechnic materials in the conductive heat mode can be related to the pressure-time record p(t), its derivative $\partial p/\partial t(t)$, and the thermodynamic properties of gaseous combustion products. These thermodynamic parameters are the isochoric flame temperature, the molecular weight and the co-volume of the combustion product gases. The mass burning rate of pyrotechnic materials in the conductive mode can also be determined directly from equilibrium thermodynamic analysis without having to find the intermediate thermodynamic properties. The calculations based on two methods are performed and the results for a typical pressure-time record are compared. Convective burning of pyrotechnic materials can be theoretically analyzed by either a complicated porous flow and heat transfer analysis or by using a very simple homogeneous model. The former is not suitable for parametric study and the latter is too simple to simulate the underlying physical phenomena. In this work a model based on two measurements of pressure-time records is proposed and discussed. The model is simple enough for parametric study while addressing important physical phenomena associated with convective burning of pyrotechnic materials in closed systems. 12 refs., 3 figs., 2 tabs.

40594 **(SAND—88-8228) A numerical study of thermal ignition.** Lutz, A.E. (Sandia National Labs., Livermore, CA (USA)). Jun 1988. Contract AC04-76DP00789. 112p. NTIS, PC A06/MF A01; 1; GPO Dep. Order Number DE88013151/JAW.

The general objective is to characterize the thermal ignition of combustible gas mixtures. Thermal ignition is the spontaneous explosion that occurs after a chemical induction period. The study emphasizes the influence of gas dynamic disturbances on the induction time and the presence of local ignition centers in the bulk mixture. The study contains three major elements. First, chemical kinetics computations are used to quantify the influence of disturbances on the induction times for homogeneous mixtures at constant volume. The constant-volume approximation is then replaced by a gas dynamic constraint to model ignition of an exothermic center. Finally, a one-dimensional model for an inert gas with energy deposition is developed to simulate the gas dynamics of the explosion.

40595 **(UCID—21410) Determination of relative flammability of materials by pyrolysis and gas-chromatographic light hydrocarbon analysis.** Priante, S.J. (Lawrence Livermore National Lab., CA (USA)). 1 Jun 1988. Contract W-7405-ENG-48. 4p. NTIS, PC A02/MF A01;1; GPO Dep. Order Number DE88012449/JAW.

We performed a series of tests to study the production of extremely flammable light hydrocarbon gases that are produced early in the degradation phase of many materials. Our tests consisted of three steps: to perform thermogravimetric analysis on a representative sample to determine its thermal history, to pyrolyze a sample portion of the material to collect the resulting degradation smoke, and then to perform gas chromatographic analysis on the gases collected in the trap. We found that if a material produces a high concentration of methane, propane, and acetylene, and has a high ratio of acetylene to both methane and propane, the material has a relatively high flammability. 3 figs.

40596 **Turbulent nonpremixed flames of methane near extinction: Mean structure from raman measurements.** Masri, A.R.; Bilger, R.W.; Dibble, R.W. (Dept. of Mechanical Engineering, The Univ. of Sydney, NSW 2006 (AU)). *Combustion and Flame;* **71**: No. 3, 245-266(Mar 1988).

Spontaneous Raman-Rayleigh measurements of species concentration-temperature have been made in turbulent nonpremixed flames of methane near extinction. The means and rms of fluctuations of temperature, density, mixture fraction, and the mass fractions of CH/sub 4/, O/sub 2/, N/sub 2/, H/sub 2/O, H/sub 2/, CO, and CO/sub 2/ are presented in this paper. The mean Raman-Rayleigh results compare favorably with probe measurements of species concentrations and temperature made in similar flames. At a

given axial location, unreactedness (finite rate kinetics) and not unmixedness [high (ξ-tilde"/sup 2/)/sup 1/2/] explains almost entirely the change in the flame structure. As the flame approaches extinction, the Favre averaged mass fractions of CH/sub 4/ and O/sub 2/ increase while those of the products H/sub 2/O, H/sub 2/, CO and CO/sub 2/ decrease. The rms of fluctuations in the temperature and mass fractions O/sub 2/, H/sub 2/O, H/sub 2/, CO, and CO/sub 2/ decrease as well. ALthough these results favor the concept of a diffuse flame structure, the existence of partially premixed laminar diffusion flamelets cannot be excluded.

42 ENGINEERING

REFER ALSO TO CITATION(S) 40004, 41120

40597 (QER—8702) Directory of Quebec enterprises active on the level of exporting energy-related products and services. Gosselin , M. (comp.). (Quebec Ministere de l'Energie et des Resources, Quebec (Canada)). Aug 1987. 59p. (In French). (MICROLOG—88-01540). Quebec Ministere de l'energie et des ressources, Direction des Communications, 200, chemin Ste-Foy, 7e etage, Quebec, P.Q., Canada G1R 4X7; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

This directory gathers 370 enterprises and 400 products, and is divided into three parts. The first identifies Quebec manufacturers/exporters according to a list of energy-related products answering the following criteria: products for producing, transporting, distributing, conserving or controlling energy; products for generating light, heat or cold; and other large energy-consuming products. The second part is an alphabetical list of the manufacturers. The third part is devoted to Quebec associations and consultants that offer energy-related services to the external market.

40598 (UCID—21412) Thermal deformations of a datum beam with a layer of epoxy. Feng, W.W.; Carter, D.L.; Hiromoto, D.S.; Nguyen, N.Q. (Lawrence Livermore National Lab., CA (USA)). 18 Apr 1988. Contract W-7405-ENG-48. 16p. NTIS, PC A03;3. Order Number DE88011753/JAW.

The results obtained from equation depend upon the material properties. The material properties used in equation are based on the published data. These quantities depend upon the curing process and may vary significantly. Overall, the test data and the result predicted from the equation indicate that the deformation is a small value and will not be of concern. 2 refs., 11 figs.

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REFER ALSO TO CITATION(S) 39200, 39201, 39257, 39273, 39321, 39354, 39394, 39395, 39404, 39431, 39495, 39714, 40163, 40174, 40205, 40249, 40304, 40355, 40384, 40735, 40768, 40924, 41099, 41102, 41142, 41145, 41245, 41748, 41749, 42075, 42419, 42436

40599 (AD-A—191233/6/XAB) Effects of NBC (nuclear, biological, and chemical) protective equipment and degraded operational mode on tank gunnery performance. Final report, October 1986-July 1987. Abel, M.H. (Army Research Inst. Field Unit, Fort Knox, TX (USA)). Oct 1987. 68p. NTIS, PC A04/MF A01.

Tank gunner's performance in the M1 Unit Conduct of Fire Trainer (UCOFT) was tested while wearing Mission Oriented Protective Posture (MOPP) gear under normal and emergency operational-mode conditions. A pretest, in both experiments, determined initial performance for possible use as a covariate on experimental test performance. In Experiment I, the subjects performed six different test exercises. Results of Experiment I indicated that MOPP gear and emergency operational mode degraded fire time, percent hits, and aiming error. MOPP gear and normal operational mode degraded aiming error only. The degradation in performance was dependent on the type of exercise. In Experiment II, the subjects performed four different test exercises. Results of Experiment II revealed degradation on all performance measures during emergency operational mode. No performance decrements were found for MOPP gear and no interaction between MOPP gear and operational mode occurred. The degradation in fire time and aiming error caused by emergency mode was dependent on the type of exercise. Multiple correlations between fire time and experience variables were significant, particularly overall time as a gunner.

40600 (AD-A—191382/1/XAB) Technology assessment for the advanced life detector. Final technical report, May 1987-January 1988. Burrows, W.D.; George, D.T. (Army Biomedical Research and Development Lab., Fort Detrick, MD (USA)). 29 Jan 1988. 21p. (USABRDL-TR—8802). NTIS, PC A03/MF A01.

This report summarizes an assessment of technology available to develop a noninvasive life detector for use on the battlefield. The detectors determine if casualties wearing chemical protective overgarments are alive or dead without further exposing either the casualties or the aidmen to the contaminated environment. Seven technology approaches sponsored by the Department of Defense (comprising 11 devices), four technologies identified in a market survey, and one device described in a Broad Agency Announcement proposal were examined as candidate Advanced Life Detectors. The technologies and instruments surveyed included three transmitter-receiver technologies, an electrocardiogram (ECG) technology, pacemaker-transmitter/receiver, dry electrode heart rate monitor, five microwave technologies, flash reflectance oximetry, an ultrasound technology, a streaming potential technology, a dry electrode ECG monitor coupled to a microphone, a statometric technique for determining heart rate and blood pressure, and a vital-signs monitor that determines heart rate and blood pressure using blood pressure cuff and microphones incorporated into the cuff. Analysis of the state-of-the-art of each device indicates that none of them are advanced enough to fulfill all the requirements of the draft Joint Services Operational Requirement. Three of the devices identified are recommended for further evaluation.

40601 (AD-A—191973/7/XAB) Night-reconnaissance operations in mission-oriented protective posture. Final memorandum report. Wick, C.H.; Morrissey, J.A.; Klopcic, J.T. (Army Armament Research and Development Command, Aberdeen Proving Ground, MD (USA). Ballistics Research Lab.). Oct 1987. 36p. (BRL-MR—3628). NTIS, PC A03/MF A01.

Military commanders are concerned about the impact chemical agents may have on operations. This is especially apparent in night reconnaissance operations which frequently require soldiers to wear mission-oriented protective posture, level IV (MOPPIV) for the duration of the mission because of uncertainty about the location of chemical hazards. To evaluate this situation and provide a quantitative estimate of the degradation in performance, eight-reconnaissance tasks were performed in a field environment, at moderate temperatures (52-84F). The tasks included: route reconnaissance, movement to two objectives, air and water samplings, hasty sketches of an objective, emplace a claymore mine, and photography of a target. These operations were performed by several teams who alternated starts while wearing the standard battle dress uniform (BDU) and the MOPPIV ensemble. Individuals were highly motivated, in high physical readiness and psychologically prepared for the operation.

40602 (BDX—613-3949) Riveting a case section with blind, self-plugging rivets: Final report. Smith, S.B. (Allied-Signal Aerospace Co., Kansas City, MO (USA). Kansas City Div.). Jun 1988. Contract AC04-76DP00613. 18p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88013224/JAW.

Blind, self-plugging, flush-head rivets, NAS1721, were installed on a case section to determine compatibility with current product and process requirements. Shear strength properties compared favorably to the solid body rivet currently used. The blind rivet was found to be a more cost effective solution toward improving riveting process time than buying upgraded riveting equipment to rivet solid body rivets. The effects of using blind rivets on secondary processes such as painting were also evaluated. 5 figs.

40803 **(BMU—1987-173) Procedures for the retention of gaseous tritium released from a tritium enrichment plant.** Gutowski, H.; Bracha, M. (Bundesministerium fuer Umwelt, Naturschutz und Reaktorsicherheit, Bonn (Germany, F.R.); Linde A.G., Muenchen (Germany, F.R.). Werksgruppe TVT). 1987. 107p. (In German). GRM Werbeberatung - Werbemittlung - PR, Eggenstein-Leopoldshafen, (Germany, F.R.).

Schriftenreihe Reaktorsicherheit und Strahlenschutz. Ergebnisberichte, Untersuchungen, Studien, Gutachten.

General aim of the study is the comparison of two alternative processes for the retention of gaseous tritium which is released during normal operation and emergency operation in a tritium-enrichment-plant. Two processes for the retention of tritium were compared: 1. Oxidation-process. The hydrogen-gas containing HT will be burnt on an oxidation catalyst to H/sub 2/O and HTO. In a subsequent step the water will be removed from the process by condensation, freezing and adsorption. 2. TROC-process (Tritium Removal by Organic Compounds). The tritium is added to an organic compound (acid) via catalyst. This reaction is irreversible and leads to solid products. (orig./RB)

40804 **(CEA-CONF—9179) Pulsed superconducting coil with low a.c. losses for use in magnetic refrigerators.** Seyfert, P.; Claudet, G. (CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France). Dept. de Recherche Fondamentale). Sep 1986. 9p. (CONF-8609433—1). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88753857/JAW.

From International cryocooler conference; Easton, MD, USA (25 Sep 1986).

A small superconducting magnetic field coil (useful bore 18 mm diameter, 100 mm length) is described which is used in pulsed operation to magnetize and demagnetize the working substance in a magnetic refrigeration device. Design features are a winding made of special low loss multifilamentary NbTi conductor with very fine filaments, a coil former and casing made of non-metallic composite material. The results of loss measurements for field pulses up to a maximum value of 3 T with a repetition rate in the 1 Hz range are given and compared with the values predicted by a model calculation. The possibilities of utilizing such coils in magnetic refrigerators are briefly discussed.

40805 **(CFI—031982) Market survey of pressure vessels for synthetic fuel production systems. Final report.** (Chinook Fuel Innovations Ltd., Calgary, Alberta (Canada)). Mar 1982. 304p. (CE—01423). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

In recognition of the need for an evaluation of the total demand to the year 2000 for heavy wall pressure vessels in the hydrocarbon conversion industries, in order to identify potential opportunities in the field and to embark on research and development programs for improving fabrication technologies and assisting industrial fabricators, a survey/forecast was conducted. The forecast evaluated the demand for pressure vessels of 63 mm and thicker wall for those energy projects that were considered likely to come to fruition in the forecast period. This evaluation included consideration of the process technologies suggested by process developers and project sponsors. Applying technology assessment principles, the likely process technologies for the next twenty years were identified and their heavy wall pressure vessel requirements for particular plant sizes determined. A mix of 25 heavy oil upgrading, oil sands and coal conversion projects were assumed to come on stream by the year 2000 and used to derive a calender of heavy wall pressure vessel procurements. An overview evaluation of the capabilities of Canadian steelmakers and vessel farbicators was carried out as well as their respective problems of competition and opportunities and the improvement of business environment. Further identified were material requirements and technological gaps in fabrication capability and Canadian steel supply, as well as opportunities for research and development programs. The opportunities for Canadian industry as a whole lie in vessels of wall thickness up to 200 mm. 93 refs., 37 figs., 13 tabs.

40806 **(CONF-880719—3) Computational methods for viscoplastic dynamic fracture mechanics analysis.** Bass, B.R.; Pugh, C.E.; Kenney-Walker, J.; Dexter, R.J.; O'Donoghue, P. E.; Schwartz, C. W. (Oak Ridge National Lab., TN (USA); Southwest Research Inst., Houston, TX (USA); Maryland Univ., College Park (USA)). 1988. Contract AC05-84OR21400. 12p. NTIS, PC A03. Order Number DE88006419/JAW.

From ASME international computers in engineering conference and exhibition; San Francisco, CA, USA (31 Jul 1988).

The role of nonlinear rate-dependent effects in the interpretation of crack run-arrest events in ductile materials is being investigated by the Heavy-Section Steel Technology (HSST) program through development and applications of viscoplastic-dynamic finite element analysis techniques. This paper describes a portion of these studies wherein various viscoplastic constitutive models and several proposed nonlinear fracture criteria are being installed in general purpose (ADINA) and special purpose (VISCRK) finite element computer program. The constitutive models implemented in these computer programs include the Bodner-Parton and the Perzyna viscoplastic formulations; the proposed fracture criteria include three parameters that are based on energy principles. The predictive capabilities of the nonlinear techniques are evaluated through applications to a series of HSST wide-plate crack-arrest tests. To assess the impact of including viscoplastic effects in the computational models, values of fracture parameters calculated in elastodynamic and viscoplastic-dynamic analyses are compared for a large wide-plate test. Finally, plans are reviewed for additional computational and experimental studies to assess the utility of viscoplastic analysis techniques in constructing a dynamic inelastic fracture mechanics model for ductile steels. 34 refs., 14 figs.

40807 **(CONF-880752—3) High definition television: Evaluation for remote task performance.** Draper, J. V.; Handel, S. J.; Herndon, J. N. (Oak Ridge National Lab., TN (USA)). 1988. Contract AC05-84OR21400. 14p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88011573/JAW.

From International symposium on teleoperation and control; Bristol, UK (12 Jul 1988).

High definition television (HDTV) transmits a video image with more than twice the number of horizontal scan lines that standard resolution television provides (1125 for HDTV to 525 for standard resolution television), with impressive picture quality improvement. These experimental activities are part of a joint collaboration between the US Department of Energy (USDOE) and the Power Reactor and Nuclear Fuel Development Corporation (PNC) of Japan in the field of the Nuclear Fuel Cycle: Reprocessing Technology. Objects in the HDTV picture have more sharply defined edges, better contrast, and more accurate shading and color pattern reproduction. Because television is a key component for teleoperator performance, picture quality improvement could mean speed and accuracy. This paper describes three experiments which evaluated the impact of HDTV on remote task performance. HDTV was compared to standard resolution, monochromatic television and standard resolution, stereoscopic, monochromatic television. Tasks included judgement of depth in a televised scene, visual inspection, and a remote maintenance task. The experiments show that HDTV can improve performance. HDTV is superior to monoscopic, monochromatic, standard resolution television and to stereoscopic television for remote inspection tasks; it is less proficient than stereo television for distance matching. HDTV leads to lower error rate during tasks but does not reduce time required to complete tasks. 6 refs., 3 figs., 3 tabs.

40808 **(CONF-8805101—1) A minisodar for emergency response and military applications.** Coulter, R.L.; Martin, T.J.; Meyers, R.E. (Argonne National Lab., IL (USA); Army Atmospheric Sciences Lab., White Sands Missile Range, NM (USA)). 1988. Contract W-31109-ENG-38. 1p. NTIS, PC A02;3. Order Number DE88010096/JAW.

From Conference on lower troposphere profiling: needs and technologies; Boulder, CO, USA (31 May 1988).

The meteorological measurement systems necessary to support military operations range from large, complex systems for supporting aircraft operations to small, simple devices for measurement

of conditions within a localized area. In particular, predictions of transport and dispersion over army depots during toxic chemical releases, or battlefields when smoke or dust dispersion is critical, require a good knowledge of the wind and turbulence field within 100 to 200 m of the surface. Similar measurements and modeling are important for emergency response where the site of the problem may not be known beforehand and in-situ measurements may not normally be available; it becomes necessary to deploy a measurement system rapidly and have its measurements immediately available to numerical models. To address these needs, we have modified the minisodar.

40609 **(CONF-8805109—1) CATIA at Martin Marietta Energy Systems.** Byington, G.A. (Oak Ridge National Lab., TN (USA)). 1988. Contract AC05-84OR21400. 24p. NTIS, PC A03;3. Order Number DE88010130/JAW.

From Catia operators exchange conference; Detroit, MI, USA (8 May 1988).

Martin Marietta Energy System's methods to manage a CATIA model, from data input to inspecton on coordinate measuring machines, will be demonstrated in this presentation. This overview of CATIA model management will include: input data format, point distribution, CATGEO and data loading, model setup, surfacing of over 2,000 points in under three hours, solid modeling, drawing production using CADAM, CATIA NC output, machining procedures, and the inspection of the machined part. The objective of this presentation is to illustrate the systematic use of CATIA in the workplace. The geometry used to illustrate this standard model management system is based on a demonstration blade shown in figure 1. This is a complicated part with over 2000 definition points, resulting in a CATIA model over 1.5 megabits in size. A standard management method is essential to provide all members of a design-build team a quick way to familiarize themselves with and revise any model. 20 figs.

40610 **(FRADOC—15-3) Knowledge-based diagnosis system for welding machine problem solving.** Bonnieres, P. de; Boutes, J.L.; Calas, M.A.; Para, S. (Societe Franco-Americaine de Constructions Atomiques (FRAMATOME), 92 - Courbevoie (France)). Jun 1986. 12p. (CONF-8606385—). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88752417/JAW.

From 1. international conference on computer technology in welding; London, UK (3 Jun 1986).

This paper presents a knowledge-based diagnosis system which can be a valuable aid in resolving malfunctions and failures encountered using the automatic hot-wire TIG weld cladding process. This knowledge-based system is currently under evaluation by welding operators at the Framatome heavy fabricating facility. Extension to other welding processes is being considered.

40611 **(GA-A—19141) Development of circumferential honeycomb impact limiters for a defense high level waste shipping cask.** Koploy, M.A.; Madsen, M.M.; Rickard, N.D.; Uncapher, W.L.; Zimmer, A. (General Atomics Co., San Diego, CA (USA)). Feb 1988. Contract AC04-80SF10791;AC04-76DP00789. 13p. (SAND—87-2882C; CONF-880201—5). NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88006650/JAW.

From Waste management '88: symposium on radioactive waste management; Tucson, AZ, USA (26 Feb 1988).

Circumferential honeycomb impact limiters provide lightweight, low-volume impact protection for nuclear waste shipping casks with circular cross sections. GA Technologies (GA) has developed an empirical procedure for designing circumferential honeycomb impact limiters to limit the impact g-level to a predetermined level. Sandia National Laboratories (SNL) has performed a series of tests demonstrating that the circumferential honeycomb impact limiters are effective and can be adequately designed using this empirical procedure. Circumferential honeycomb impact limiters are currently used on the Defense High Level Waste (DHLW) truck shipping cask and are planned for use on several new casks which are scheduled for development during the next few years. This paper describes the structural design of the circumferential honeycomb impact limiters, presents the empirical design procedure for predicting the impact g-level and required volume of honeycomb, and compares test results with predicted results. 1 ref., 3 figs.

40612 **(INIS-SU—19/A) Thermal calculations of nitrogen-free nonmagnetic helium cryostats.** Doroshko, A.I.; Zhitomirskij, I.S.; Kvasha, D.I.; Romanenko, V.G.; Sirenko, V.A. (AN Ukrainskoj SSR, Kharkov. Fiziko-Tekhnicheskij Inst. Nizkikh Temperatur). 1987. 16p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702807/JAW.

Preprint--28-87.

Thermal calculations of nitrogen-free helium cryostats are made using a program of hydraulic-thermal calculations for complex cryosystems "TEPGIST". A comparison with the experimental is presented, the influence of a number of factors on cryostat resources is studied and an automatic man-machine selection system of optimal design parameters is proposed.

40613 **(INIS-SU—21) Peculiarities of heat transfer at helium boiling in centrifugal force field.** Kirichenko, Yu.A.; Rusanov, K.V. (AN Ukrainskoj SSR, Kharkov. Fiziko-Tekhnicheskij Inst. Nizkikh Temperatur). 1987. 23p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702809/JAW.

Preprint--20-87.

A new interpretation is given to some new effects observed at helium boiling in an intensive centrifugal force field. Formulas taking into account the influence of these effects on the heat transfer characteristics are proposed. A method is developed for evaluating the first critical density of the thermal flux during liquid boiling at differently oriented flat surfaces.

40614 **(JET-R—87-16) Practical experience of using special remote handling tools on JET.** Mills, S.F.; Schriebmaier, J.; Tesini, A.; Wykes, M. (Commission of the European Communities, Abingdon (UK). JET Joint Undertaking). 1987. 17p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88754143/JAW.

Over 50 cutting and 200 UHV welding operations were made during the installation of new water cooled belt limiters and ICRF Antennae into the JET Vacuum Vessel. This work was performed by the hands-on use of 45 special tools which have been specifically designed for use with the Mascot servomanipulator in preparation for the JET D-T phase when all maintenance will be performed remotely. This paper reports on the techniques used and the performance of the tools.

40615 **(K/ETAC—66) Naval Underwater Systems Center Torpedo Data Acquisition center: Dry system conceptual design report.** Jordan, J.K.; Napier, R.W.; Scudiere, M.B. (Oak Ridge National Lab., TN (USA)). May 1988. Contract AC05-84OT21400;AC05-84OR21400. 23p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88010503/JAW.

A digital data acquisition system, the "wet" system, is being developed to acquire and record sensor data in torpedo test vehicles. This document defines the conceptual design for a "dry" system which will be used for programming the wet system, handling the test data, and performing "quick-look" signal analysis.

40616 **(N—88-21468) 22nd aerospace mechanisms symposium.** (National Aeronautics and Space Administration, Hampton, VA (USA). Langley Research Center). May 1988. 416p. (NASA-CP—2506; L—16433; NAS—1.55:2506; CONF-880545—). NTIS, PC A18/MF A01.

From 22. aerospace mechanisms symposium; Hampton, VA, USA (4 May 1988).

The proceedings of the symposium, which was held at the NASA Langley Research Center, on May 4 to 6, 1988, are reported. Technological areas covered include space lubrication, bearings, aerodynamic devices, spacecraft latches, deployment, positioning, and pointing. Devices for space station docking and manipulator and teleoperator mechanisms are also described.

40617 (N—88-21468, pp vp) **Development of a motorized cryovalve for the control of superfluid liquid helium.** Lorell, K.R.; Aubrun, J.N.; Zacharie, D.F.; Frank, D.J. May 1988. NTIS, PC A18/MF A01. (NASA-CP—2506; L—16433; NAS—1.55:2506; CONF-880545—).

From 22. aerospace mechanisms symposium; Hampton, VA, USA (4 May 1988).

Recent advances in the technology of infrared detectors have made possible a wide range of scientific measurements and investigations. One of the requirements for the use of sensitive IR detectors is that the entire instrument be cooled to temperatures approaching absolute zero. The cryogenic cooling system for these instruments is commonly designed as a large dewar containing liquid helium which completely surrounds the apparatus. Thus, there is a need for a remotely controlled, motorized cryovalve that is simple, reliable, and compact and can operate over extended periods of time in cryo-vac conditions. The design, development, and test of a motorized cryovalve with application to a variety of cryogenic systems currently under development is described.

40618 (NP—8770289) Studies on the removal of spoil banks and tailings dumps. Bock, K. (Technische Hochschule Aachen (Germany, F.R.). Fakultaet fuer Bergbau und Huettenwesen). 14 Mar 1986. 164p. (In German). NTIS (US Sales Only), PC A08. Order Number DE88770289/JAW.

In view of the energy price situation and the limitation of resources, the author investigates how to make use of the valuable materials contained in spoil banks. Discussed are: Reasons for raw materials recovery from spoil banks, examples of recovery technologies and spoil bank types, spoil banks as raw materials deposits, comparison of recovery techniques, comparison of the systems 'bucket wheel excavator plus belt conveyor' and 'wheel loader plus heavy-duty lorries'. If the annual production is higher than 200.000 to 300.000 loose cubic meters, continuous operation is more cost-efficient than discontinuous operation. Although the author's results are not universally applicable, they provide a basis for detailed planning of individual projects. (MOS).

40619 (OH/RD—87/265/K) Trip report: 1987 Cryogenic Engineering Conference/International Cryogenic Materials Conference. Robins, J.R. (Ontario Hydro Research Div., Toronto (Canada)). 19 Nov 1987. 10p. (MICROLOG—88-01749; CONF-8706300—). Ontario Hydro Research Division, Editorial Section, 800 Kipling Ave., Toronto, Ont., Canada M8Z 5S4; $10.00 CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

From 7. international cryogenic materials conference; St. Charles, IL, USA (14 Jun 1987).

This report provides an outline of presentations attended by Ontario Hydro's observer at a conference on cryogenic engineering and materials. A tour of a cryogenic laboratory is described; there is discussion on recent research into cryogenic refrigeration. New high-temperature oxide superconductors and their possible uses are mentioned. Includes a list of conference preprints available from the author.

40620 (PB—88-197090/XAB) Distortion of the field distribution of a magnet using tape superconductors. Umeda, M.; Hirasawa, T.; Watanabe, M. (Electrotechnical Lab., Sakura, Ibaraki (Japan)). 1987. 10p. (In Japanese). NTIS, PC E05.

Included in Bulletin of the Electrotechnical Laboratory, Vol. 51, No. 7 10-18(1987).

A calculation model for distortion of the axial field distribtuion of a magnet made of tape superconductors has been proposed, and experimental results are in good accordance with calculated values. Shield currents induced in tapes by a radial field applied normal to the tape face mainly distort the design field. Value of the distortion field depends on tape width and magnet geometry. Hysteresis of the central field increases with increasing tape width and when the ratio of outer to inner radius is equal to that of magnet height to inner radius. On a magnet made of 5-mm-wide Nb_3Sn tape, the value of the central field was reduced by 5% at a design field of 10T, while the central residual field remained 0.35T.

40621 (PB—88-205588/XAB) Development of a new Nb_3Ge superconducting material long enough for construction of a very high field magnet. Senet, E. (Centre National de la Recherche Scientifique, 38 - Grenoble (France)). 1988. 63p. (In French). NTIS, PC E04/MF E04.

The SNCI, in collaboration with the Materials and Physical Engineering Laboratory, has developed and studied an original technique for continuous CVD, based on radiative heating of the tape. Extended-time tests of this technique showed it could be used to synthesize long strips of homogenous superconducting tape. Advantages of this method, compared to already-existing methods, are discussed. One problem with the method, however, is that the deposits that form around the edges of the tape are thicker than those in the center; to limit the thickness of the edge deposits, center deposits must be kept below 10 micrometers per side, which limits conductibility. Operating at low pressures may solve the problem, which is probably linked to gas flow in the reactor.

40622 (RFP—4171) HEPA [high efficiency particulate air] filter optimization/implementation. Nenni, J.A. (USDOE Albuquerque Operations Office, NM; Rockwell International Corp., Golden, CO (USA). Rocky Flats Plant). 10 Feb 1988. Contract AC04-76DP03533. 8p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88013615/JAW.

Prefilters were installed in high efficiency particularly air (HEPA) filter plenums at the Rocky Flats Plant. It was determined that prefiltration systems would extend the life of first-stage HEPA filters and reduce the amount of HEPA filter waste in the transuranic waste category. A remote handling system was designed to remove prefilters without entry into the plenum to reduce secondary waste and decrease exposure to Filter Technicians. 3 figs., 4 tabs.

40623 (SAND—87-2755C) In-flight motor torque estimates for the second-stage Strypi IX launch vehicle. Edmunds, R.S. (Sandia National Labs., Albuquerque, NM (USA)). 1988. Contract AC04-76DP00789. 8p. (CONF-880764—1). NTIS, PC A02;3. Order Number DE88010833/JAW.

From 24. AIAA/ASME/SAE/ASEE joint propulsion conference; Boston, MA, USA (11 Jul 1988).

This paper documents the results of a study to determine the character of body fixed torques generated by the Anteres IIA motor, during second-stage burn of the Strypi IX launch vehicle. The Strypi IX is a two-stage spin-stabilized solid-propellant launch vehicle designed to boost a variety of payloads to reentry environment conditions. The torque estimates were determined from post-flight analysis of Euler angle telemetry data. Principal axis misalignments, and thrust misalignments were also estimated. Data was analyzed from two separate launches; a Precursor and a Prime flight. 21 figs.

40624 (SAND—87-3129) Film-based computed tomography of the debris formation experiment packages. Hansche, B.D. (Sandia National Labs., Albuquerque, NM (USA)). Apr 1988. Contract AC04-76DP00789. 23p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88010373/JAW.

The Debris Formation/Relocation experiments are a series of nuclear accident simulations to study the effect of overtemperature conditions on the fuel rods. After each test, the experiment package was radiographed from multiple angles. The radiographs were digitized, and the data was used as the input to a computed tomography image reconstruction process. Film calibration, reconstruction, and image display techniques are discussed. 7 refs. ,13 figs.

40625 (SAND—88-0037C) Parameter identification of material constants in a composite shell structure. Martinez, D.R.; Carne, T.G. (Sandia National Labs., Albuquerque, NM (USA)). 1988. Contract AC04-76DP00789. 41p. (CONF-880376—1). NTIS, PC A03/MF A01;3. Order Number TI88008115/JAW.

From California Institute of Technology/USAF/NASA workshop; Pasadena, CA, USA (22 Mar 1988).

One of the basic requirements in engineering analysis is the development of a mathematical model describing the system. Frequently, comparisons with test data are used as a measurement of the adequacy of the model. An attempt is typically made to update or improve the model to provide a test-verified analysis tool. System identification provides a systematic procedure for accomplishing this task. The terms system identification, parameter estimation, and model correlation all refer to techniques that use test

information to update or verify mathematical models. The goal of system identification is to improve the correlation of model predictions with measured test data, and produce accurate, predictive models. For nonmetallic structures the modeling task is often difficult due to uncertainties in the elastic constants. In this work a parameter identification procedure was used to determine the elastic constants of a cylindrical, graphite epoxy composite shell. A finite element model of the shell was created, which included uncertain orthotropic elastic constants. A modal survey test was then performed on the shell. The resulting modal data, along with the finite element model of the shell, were used in a Bayes estimation algorithm. This permitted the use of covariance matrices to weight the confidence in the initial parameter values as well as confidence in the measured test data. The estimation procedure also employed the concept of successive linearization to obtain an approximate solution to the original nonlinear estimation problem. 17 refs., 7 figs.

40626 (SAND—88-8205) Fiber-optics used to record high-speed photographs inside a pressurized tank during lethality testing. Grant, J.E. (Sandia National Labs., Livermore, CA (USA)). Apr 1988. Contract AC04-76DR00789. 32p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88011283/JAW.

Sandia National Laboratories has a program underway to determine the survivability and lethality of potential targets subjected to high order impulse loads. This effort is associated with the Strategic Defense Initiative's (SDI) Directed Energy Weapons (DEW) program and is managed by the Defense Nuclear Agency (DNA). The energy from this class of weapons, impact the target surface simultaneously and produce an impulse that varies as the cosine of the angle of incidence. The goals of the program are to determine the relevant failure mechanisms, assess the validity of our numerical codes in modeling target behavior, provide a series of benchmark tests that can be used to improve our numerical capability, and provide the SDI community with estimates of survivability and lethality levels for various generic targets. The experiment described in this report is one in a series of similar experiments designed to model target behavior in the absence of material degradation and spall. 3 refs., 10 figs.

40627 (UCID—21418) Mechanical behavior of nuclear test canisters. McCallen, D.B.; Trummer, D.J. (Lawrence Livermore National Lab., CA (USA)). 25 Mar 1988. Contract W-7405-ENG-48. 76p. NTIS, PC A05/MF A01;1; GPO Dep. Order Number DE88011751/JAW.

An equivalent continuum methodology is used to construct structural models of test canisters for numerical simulations and parameter studies. The continuum method models the canister structures with a solid beam-like structure which is {open←quotes}equivalent{close←quotes} to the extent that it exhibits the same global planar force-displacement characteristics as the actual canister structure. The continuum models yield computationally efficient reduced order structural models. The continuum model admits three global canister deformation modes (i.e., global axial, shear and bending deformations) and allows the analyst to discriminate between the contributions from each deformation mode. Consequently, the continuum model gives insight into the mechanics of canister deformations which would not be easily obtainable from classical discrete finite element models. The continuum models have been rigorously checked by comparison with large discrete finite element results and measured canister behavior. 19 refs., 41 figs.

40628 (UCRL—97385) Plasma armature formation in high-pressure, high-velocity hydrogen. Hawke, R.S.; Susoeff, A.R.; Asay, J.R.; Hall, C.A.; Konrad, C.H.; Hickman, R.J.; Sauve, J.L. (Lawrence Livermore National Lab., CA (USA); Sandia National Labs., Albuquerque, NM (USA); Ktech Corp., Albuquerque, NM (USA); EG and G, Inc., Albuquerque, NM (USA)). 1 Mar 1988. Contract W-7405-ENG-48. 5p. (CONF-880478—11). NTIS, PC A02/MF A01;1; GPO Dep. Order Number DE88008347/JAW.

From 4. symposium on electromagnetic launch technology; Austin, TX, USA (12 Apr 1988).

The use of a two-stage light-gas gun (2SLGG) as a preaccelerator in combination with a railgun is expected to significantly reduce barrel ablation and improve overall performance. In particular, the use of a hydrogen 2SLGG provides injection velocities of 6 to 8 km/s and a pure hydrogen environment immediately behind the projectile as it enters a railgun. To continue acceleration of the projectile, a plasma armature must be formed. We explored two methods of converting a portion of the fast-moving hydrogen gas into a plasma armature capable of supporting currents exceeding 100 kA. We report on the results of these studies. This work is part of STARFIRE, the joint Sandia National Laboratories/Lawrence Livermore National Laboratory project to develop a hypervelocity railgun. 11 refs., 4 figs., 1 tab.

40629 (UCRL—97520-Rev.1) A new glove-box system for a high-pressure tritium pump. Wilson, S.W.; Borree, R.J.; Chambers, D.I.; Chang, Y.; Merrill, J.T.; Souers, P.C.; Wiggins, R.K. (Lawrence Livermore National Lab., CA (USA)). 26 May 1988. Contract W-7405-ENG-48. 6p. (CONF-880505—22-Rev.1). NTIS, PC A02/MF A01;1; GPO Dep. Order Number DE88011727/JAW.

From 3. topical meeting on tritium technology in fission, fusion and isotopic applications; Toronto, Canada (1 May 1988).

A new glove-box system that was designed around a high-pressure tritium pump is described. The system incorporates new containment ideas such as "burpler" passive pressure controls, valves that can be turned from outside the box, inflatable door seals, ferro-fluidic motor-shaft seals, and rapid box-to-hood conversion during cryostaging. Currently under construction, the system will contain nine separate sections with automatic pressure-balancing and venting systems. 3 refs., 5 figs.

40630 (UCRL—97846) HPM simulation fidelity studies. King, R.J.; Hudson, H.G. (Lawrence Livermore National Lab., CA (USA)). Jun 1988. Contract W-7405-ENG-48. 11p. (CONF-8805132—7). NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88012229/JAW.

From 4. national high power microwave conference; Monterey, CA, USA (9 May 1988).

In testing full systems in High Power Microwave (HPM) simulators, there may be need to expose one or a few POEs at a time in the near-field of the source antenna. In doing so, several important issues must be addressed: What is the near-field structure of the source antenna and how does it affect coupling? Are there significant mutual interactions between the source antenna and the test object? Between the POEs? How does the phase front of an incident wave contribute to coupling via multiple POEs? Can near-field tests on individual POEs be superimposed to predict the coupling response to plane wave (far-field) illumination of multiple POEs? Does near-field receiving cross-section have meaning, and if so, how does it compare with the far-field cross section? Which are the most important POEs and at what frequencies are they important? This paper gives an overview of many of these issues and sites examples. Experimental results are given for near-field coupling into a generic test object. While we do not exhaustively answer all of these questions, certain trends are observed. From these, some general conclusions are drawn to guide the use of HPM simulators for testing full systems.

40631 (UCRL—98910) Design and performance of the SSVCO. Poulsen, P.; Morrison, J.J.; Chase, J.B.; Domning, E.E.; Hawke, R.S.; Takemori, H.T.; Vogtlin, G.E. (Lawrence Livermore National Lab., CA (USA)). 13 Jun 1988. Contract W-7405-ENG-48. 9p. (CONF-8805132—10). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88012435/JAW.

From 4. national high power microwave conference; Monterey, CA, USA (9 May 1988).

A magnetized and tunable virtual cathode oscillator with radial extraction of RF power (SSVCO) has been constructed. The diagnostic chamber guides the RF power to an array of orthogonal sets of dipole antennas which provide accurate power measurement over a wide range of power, polarization, frequencies, and directions of the incident power. The vacuum chamber incorporates liquid nitrogen pumping which, in combination with prepulsing the beam, substantially extends the RF pulse duration and the delivered energy. The results indicate that ions formed at the anode surface will flow into the electron beam, causing space charge neutraliza-

tion, and terminating the RF pulse. Cleaning the system by prepulsing and pumping decreases the rate of ion formation and extends the RF pulse. Conditions for which the reflexing and the beam frequency are equal have been found to produce instantaneous efficiencies of RF production as high as 20%. 3 refs., 10 figs.

40632 **(VTT-TIED—832) Reduced municipal engineering. Frost protection and thermal insulation of pipelines in Elimaeki Nappa experimental building area.** Kivikoski, H. (Valtion Teknillinen Tutkimuskeskus, Espoo (Finland)). Feb 1988. 85p. (In Finnish). NTIS (US Sales Only), PC A05. Order Number DE88753770/JAW.

To follow up the behaviour of the frost protection of the shallow laid pipeline in Elimaeki Nappa, 200 temperature sensors were installed in 31 cross-sections. The temperatures at the cross-sections presented are results of the measurements during the winters 1985-1987, which were considerably colder than an average winter. The ventilation of the sewer on a cold winter day was studied by means of temperature measurements in manholes. The water contents and densities of the materials used for pipe insulations were determined 4.5 years after the installation. The applicability of the instructions for frost protection and thermal insulation of shallow laid pipelines to dimensioning is estimated on the basis of temperature measurements during the winter 1986-1987, which, as for the cold content, nearly corresponds to the dimensioning conditions. In addition, the experiences from planning and construction of reduced municipal engineering are presented.

40633 **(PB—88-204821/XAB) Presentation of results of Critical Operations Robot research and development.** (Critical Operations Robot Technology Research Association, Tokyo (Japan)). Apr 1988. Trans. of unidentified mono., 224p. See also PB—88-140033. 224p. NTIS, PC E10/MF E10.

The Critical Operations Robot Project was established in February 1984 as a Japanese National Large-Scale Industrial Technology program. Its objective is to produce a series of mobile, remote-controlled robots capable of operating under various environmental conditions that would be severely hazardous to humans. Developmental efforts currently involve three robot types: (1) a robot capable of undertaking practical operations in a nuclear power-generating facility, such as inspection and maintenance; (2) an underwater petroleum production support robot capable of performing high-level operations, such as maintenance, inspection and repair, on offshore platforms; (3) a petroleum production facility disaster-prevention robot that is intended to carry out tasks in refineries such as comprehending disaster conditions, preventing expansion of the disaster, rescuing victims, etc. The document provides a detailed technical review of progress on the project through mid-1987.

40634 **Superconductivity policy perspectives: from laboratory to market.** Schriesheim, A. (Argonne National Lab., IL (USA)). *Forum for Applied Research and Public Policy (Knoxville, Tennessee);* 3: No. 1, 68-71(Spr 1988).

Winning the race to commercialize high-temperature superconductors demands that institutional challenges be met as well as scientific and technical ones. The federal government must resist the temptation to steer the commercialization process toward specific products, and it must work to further speed the licensing of government patents to industry. At the same time, greater efforts are needed to stimulate strong programs in which scientists from government laboratories and academia work side by side with their colleagues from industry, preferably on a daily basis. There is no clear, step-by-step process that will lead to the successful market introduction of commercial products based on high-temperature superconductors. The key to success is for government to support a wide array of basic research needed to understand the new materials and to transfer that knowledge as quickly as possible to industry. If this can be done, the US will win the race. If not, American consumers will still benefit from products based on high-temperature superconductors. But many of these products will be produced overseas, and the profits and jobs they generate will go to other nations.

40635 **(DOE-tr—88-17) Fracture toughness correlations.** Wallin, K. (Valtion Teknillinen Tutkimuskeskus, Espoo (Finland). Metals Lab.). 1988. TRANSLATION OF TECHNICAL RESEARCH CENTRE OF FINLAND, RESEARCH REPORTS 428. 57p. NTIS, PC A04;3.

In this study, existing fracture parameter correlations are reviewed. Their applicability and reliability are discussed in detail. A new K/sub IC/-CVN correlation, based on theoretical brittle fracture model, is presented.

40636 **Transient stability of large scale superconductors cooled in superfluid helium.** Waynert, J.; Eyssa, Y.; Huang, X. (Astronautics Technology Center, Madison, WI (USA)). pp 187-194 of Advances in cryogenic engineering. Volume 33. Fast, R.W. (ed.). New York, NY; Plenum Press (1988). (CONF-8706125—). Contract AC03-85SF15934.

From Cryogenic engineering conference; St. Charles, IL, USA (14 Jun 1987).

The transient stability of cylindrical and rectangular monolithic superconductors cooled by He II is discussed. The analysis assumes that a long normal zone exists such that end effects may be neglected. The time-dependent Joule heating of the conductor is calculated based on the magnetic diffusion of the transport current into the stabilizing matrix. The effects of cooldown, cyclic strain, and magnetoresistivity on the high purity stabilizing material are considered. Results for transient heat transfer in the superfluid for both geometries are presented. The effects of using temperature dependent thermodynamic properties for the superfluid are discussed. Both the heat generation and cooling as functions of time are used to discuss conductor design and the associated stability margin.

40637 **Evolution of normal zones and temperature in a superconductor cooled internally with helium-II.** Canavan, E.R.; Van Sciver, S.W. (Univ. of Wisconsin, Madison (USA)). pp 195-202 of Advances in cryogenic engineering. Volume 33. Fast, R.W. (ed.). New York, NY; Plenum Press (1988). (CONF-8706125—). Contract AC02-82ER52077.

From Cryogenic engineering conference; St. Charles, IL, USA (14 Jun 1987).

Measurements were made on a hollow composite conductor open at both ends to a subcooled He II bath. The vacuum insulated conductor carried a transport current in a transverse background field of up to 11 Tesla. Heaters mounted on the conductor at its center were used to initiate local disturbances. The propagation or collapse of these disturbances was observed using a series of temperature sensors and voltage taps attached symmetrically about the heater. The stability margin of the conductor was mapped out and the pressure rise and thermal expulsion velocity were derived from the voltage and temperature profiles.

40638 **Theory and technique for reducing the effect of cracks in multilayer insulation from room temperature to 77 K.** Shu, Q.S.; Fast, R.W.; Hart, H.L. (Fermi National Accelerator Lab., Batavia, IL (USA)). pp 291-298 of Advances in cryogenic engineering. Volume 33. Fast, R.W. (ed.). New York, NY; Plenum Press (1988). (CONF-8706125—).

From Cryogenic engineering conference; St. Charles, IL, USA (14 Jun 1987).

The dependence of the heat load on crack width, depth, and geometry, on the properties of the cold surface under the crack, and on overall vacuum pressure were studied. Aluminized Mylar patches covering the cracks were effective in reducing the heat load. Using the optimum number and distribution of patches determined by experiment it was possible to eliminate the effect of cracks on the overall heat load. To understand the mechanism of heat transfer through cracks the temperature distribution in the multilayer insulation adjacent to cracks was measured. A model was developed to explain this black crack phenomenon and provide more quantitative heat leak estimates.

40639 **Crack covering patch technique to reduce the heat flux from 77 K to 4.2 K through multilayer insulation.** Shu, Q.S.; Fast, R.W.; Hart, H.L. (Fermi National Accelerator Lab., Batavia, IL (USA)). pp 299-304 of Advances in cryogenic engineering. Volume 33. Fast, R.W. (ed.). New York, NY; Plenum Press (1988). (CONF-8706125—).

From Cryogenic engineering conference; St. Charles, IL, USA (14 Jun 1987).

The technique of crack patching and the enhanced black cavity model developed to reduce heat flux in a multilayer insulation blanket to a room temperature-77 K surface were applied to the 77-4.2 K situation. The optimized patch covering technique was also effective in this range. The heat load through cracks in this range, as calculated by the enhanced black cavity model, agreed with the experimental data. Temperature distribution was measured and the corresponding equivalent thermal conductivity of the cracks was deduced.

40640 **Operating experiences and test results of six cold helium compressors.** Brown, D.P.; Gibbs, R.J.; Schlafke, A.P.; Sondericker, J.H.; Wu, K.C. (Brookhaven National Lab., Upton, NY (USA)). pp 663-674 of Advances in cryogenic engineering. Volume 33. Fast, R.W. (ed.). New York, NY; Plenum Press (1988). (CONF-8706125—).

From Cryogenic engineering conference; St. Charles, IL, USA (14 Jun 1987).

Three small and three large centrifugal compressors were in operation at Brookhaven National Laboratory between 1981 and 1986. The three large units are components of the Brookhaven 24.8 KW refrigerator for testing a string of superconducting magnets and for R&D purposes. One small circulating compressor tested employs tilting-pad gas bearings and is driven by a DC motor. The two small cold vacuum pumps tested use oil bearings and are driven by oil turbines. Results on performance, reliability, and adiabatic efficiency are discussed.

40641 **Miniature cryogenic high vacuum valve.** Siegwarth, J.D.; Voth, R.O. (National Bureau of Standards, Boulder, CO (USA)). pp 1153-1159 of Advances in cryogenic engineering. Volume 33. Fast, R.W. (ed.). New York, NY; Plenum Press (1988). (CONF-8706125—).

From Cryogenic engineering conference; St. Charles, IL, USA (14 Jun 1987).

A miniature valve has been built for use in a liquid hydrogen handling system. The valve stem tip consists of a polycarbonate resin which closes against a stainless steel seat. Additional features of the valve include a closing mechanism that is helium gas operated and a bellows stem seal that allows the valve to open and close without changing the internal volume. Design and test results are presented.

40642 **A simple model for the optimization of stand-off hypervelocity particle shields.** Lawrence, R.J. (Strategic Defense Div., Sandia National Labs., Albuquerque, NM (US)). pp 451-462 of Hypervelocity impact. Anderson, C.E. Elmsford, NY; Pergamon Books Inc. (1987). (CONF-861091—).

From Hypervelocity impact symposium; San Antonio, TX, USA (21 Oct 1986).

Impacts at extreme velocities of many tens or even hundreds of kilometers per second are essentially inaccessible to experiment; hence, theory and the resulting scaling laws are the only means to describe the relevant phenomena. One area amenable to this approach involves analyzing the efficacy of stand-off shields for protection against hypervelocity particles. A simple model that allows for optimal design of these shields is developed. Examples and scaling laws that provide estimates for the minimum requirements for such shields are derived from the model.

40643 **Abrikosov vortex motion and elementary pinning force in a SNS Josephson junction.** Hyun, O. Ames, IA; Iowa State Univ. (1987). 176p. University Microfilms Order No. 87-21,894.

Thesis (Ph. D.).

Procedures have been developed to determine the location of a single Abrikosov vortex in a Superconductor - Normal metal - Superconductor (SNS) Josephson junction and study its motion under the influence of a Lorentz force. A vortex in a SNS junction generates characteristic magnetic field inside the junction and this field, in turn, induces a specified phase across the junction. This phase caused by the vortex changes the critical current characteristics of the junction, that then can be used to locate the vortex inside the junction. A single vortex was successfully trapped in the junction by the field cooling process and the location was determined by the diffraction pattern. Motion of the vortex was induced by the transport current, I/sub p/, and the vortex was found to move in discrete jumps. By tracing the vortex after successive depinning events, many pinning centers could be identified. From the minimum depinning current, the elementary pinning force associated with an individual pinning site of the Pb - Bi(4%) superconducting layer was measured. The force is asymmetric and different from one pinning site to another. For the given SNS junction, the pinning force of a pinning center is dominant over all other forces associated with the vortex in the junction.

4203 Lasers

REFER ALSO TO CITATION(S) 40372, 40373, 40374, 40375, 40465, 40466, 40467, 40468, 40504, 41246, 41728, 42009, 42227, 42228, 42415

40644 **(AD-A—190244/4/XAB) Alkali-metal diffuse-band lasers. Final technical report, 1 June 1986-31 May 1987.** Stwalley, W.C. (Iowa Univ., Iowa City (USA)). 12 Aug 1987. 19p. (IADBL—3). NTIS, PC A03/MF A01.

Progress is described on study of a new class of potential excimer lasers based on diffuse bands of the alkali metal vapors. In particular, the violet diffuse bands of sodium vapor and the yellow diffuse bands of potassium vapor are shown by detailed modeling of single vibrational-rotational level emission to be each composed of overlapping singlet and triplet excimer emission continua of the diatomic molecule. The gain and low absorption loss previously found in the violet and yellow with laser optical pumping of sodium vapor and potassium vapor, respectively, were quantitatively examined. Prospects for laser oscillation appear to be good at low pressures where quenching is not dominant. Free-bound-free spectra (which include only the triplet portion of the diffuse bands) have been produced and analyzed in sodium, potassium, rubidium, and cesium.

40645 **(AD-A—190438/2/XAB) NRL 1.3-micrometer high-power single-element laser diode. Monthly report No. 9.** (TRW Space and Technology Group, Redondo Beach, CA (USA). Applied Technology Div.). Oct 1987. 4p. (TRW-MR—9). NTIS, PC A02/MF A01.

As discussed in last month's technical report (Monthly Report No. 8, September 1987), an examination of the characteristics of devices made indicate several problems. Slope efficiencies (nd) are low, averaging between 0.20 and 0.30 mW/mA range. Also, the far-field characteristics of most devices show multiple-lobed structures, indicative of interference of radiation from several sources. There are some devices with stable, smooth far-field patterns, but they are a minority. To analyze this problem, devices with no facet coatings had their far-field characteristics measured and then underwent SEM analysis of the device's cross section as viewed from the front facet. The SEM micrographs were attached to the far-field plots and a comparison was made across several devices. The SEM micrographs reveal extraneous and irregular crystal growth (of the epitaxial layer that forms the active region) along the walls of the V-channel. SEM micrographs of every device that showed this anomalous crystal growth on the walls of the V-channel correspond to far-field patterns characterized by multiple lobes.

40646 **(AD-A—190473/9/XAB) Program to research laser-driven thermionic electron sources for free-electron lasers. Final report.** (Thermo Electron Corp., Waltham, MA (USA)). Jan 1988. 38p. (TE—4327-20-88). NTIS, PC A03/MF A01.

This is the Final Report on the research and development of high-brightness pulse-laser-driven thermionic electron sources. Enhanced coupling of electron-beam energies to radiative fields in accelerator-driven free-electron lasers requires injector cathodes of higher brightness than is possible with conventional dispenser cath-

odes or plasma-forming field emitters. Cesiated refractory surfaces and dispenser cathodes that are pulse-laser heated may offer such an increase in brightness, by the emission of monoenergetic beams of electrons at high current densities. The studies were designed to investigate the emission characteristics of both of these types of thermionic cathodes.

40647 **(AD-A—190860/7/XAB) Generation of tunable coherent radiation in 3 micrometers-5 micrometers region using semiconductor lasers in external cavities. Final report, August 1985-July 1986.** Salour, M.M. (Tacan Corp., Carlsbad, CA (USA)). Nov 1987. 32p. NTIS, PC A03/MF A01.

This report describes the first optically pumped mode-locked PbS(1-x)Se(x) semiconductor lasers with an external cavity with the following specifications: (1) observed lasing as high as 150K, (2) operated c-w mode-locked as low as 8K; (3) maximum output average power was 1 mW at 4.1 micrometers and 0.6 mw at 4.8 micrometers; and (4) Wavelength span from 4 micro m - 5 micro m possible.

40648 **(AD-A—190864/9/XAB) New UCSB (University of California, Santa Barbara) compact far-infrared FEL. Technical report No. 2, January 1986-January 1987.** Ramian, G.; Elias, L. (California Univ., Santa Barbara (USA). Quantum Inst.). Nov 1987. 7p. NTIS, PC A02/MF A01.

A 2 megavolt electrostatic accelerator is being acquired by the FEL development group at UCSB. This machine is being designed to provide an exceptionally low-emittance electron beam suitable for a wide range of FEL-related experiments. Foremost among these will be development of a compact submillimeter FEL employing next-generation electrostatic accelerator FEL concepts. It is expected that this machine will serve as prototype for a new generation of FELs all based on commercially available electrostatic accelerators ranging in voltage from .5 to 25 Megavolts. High-voltage tests are expected to begin as early as 1988.

40649 **(AD-A—190875/5/XAB) Unstable behavior of lasers and other optical systems. Final report, October 1985-August 1987.** Narducci, L.N.; Tredicce, J.R.; Yuan, J.M.; Abraham, N.B. (Drexel Univ., Philadelphia, PA (USA). Dept. of Physics and Atmospheric Science). 27 Nov 1987. 63p. NTIS, PC A04/MF A01.

This final report summarizes the theoretical and experimental activities carried out jointly by the Quantum Optics Group at Drexel University and the Nonlinear Dynamics and Laser Physics Group at Bryn Mawr College during the period October 15, 1985 - August 31, 1987. The report includes detailed reviews of major findings in the study of laser dynamics, especially theoretically, but also experimentally, and summaries of other parallel studies on Stimulated Raman Scattering (SRS) and nonlinear dynamics. Emphasis was on the formulation of a generalized version of the Maxwell-Bloch equations for the laser to include transverse degrees of freedom. The authors succeeded in developing this model and investigated in detail its steady-state and linear-stability properties. The main result is the discovery of low-threshold unstable behaviors and the identification of their physical origin.

40650 **(AD-A—190969/6/XAB) Bibliography of Soviet laser developments, Number 83, May-June 1986.** (Defense Intelligence Agency, Washington, DC (USA). Directorate for Scientific and Technical Intelligence). Sep 1987. 133p. (DIA-DST—2700Z-007-87). NTIS, PC A07/MF A01.

This is the Soviet Laser Bibliography for May-June 1986, and is No. 83 in a continuing series on Soviet laser developments. The coverage includes basic research on solid-state, liquid, gas, and chemical lasers; components; nonlinear optics; spectroscopy of laser materials; ultrashort pulse generation; theoretical aspects of advanced lasers; and general laser theory. Laser applications are listed under biological effects; communications systems; beam propagation; adaptive optics; computer technology; holography; laser-induced chemical reactions; measurement of laser parameters; laser measurement applications; laser-excited optical effects; laser spectroscopy; beam-target interaction; and plasma generation and diagnostics.

40651 **(AD-A—191084/3/XAB) Laser-comparison study of Nd:BEL and Nd:YAG. Final report, December 1985-June 1986.** Simpson, R.C. (Air Force Wright Aeronautical Labs., Wright-Patterson AFB, OH (USA)). Oct 1987. 52p. (AFWAL-TR—87-1130). NTIS, PC A04/MF A01.

Except for a few early instances, military tactical lasers have used Nd(3+) doped $Y_3Al_5O_{12}$ (Nd:YAG) as the laser material. With an output wavelength of 1.064 micrometers and an optimum slope efficiency near 3.0%, the performance of this solid-state material is well known (1), while the use of other materials is currently being evaluated. To provide an advantage over Nd:YAG, issues such as efficiency, beam quality, reliability, and availability must be considered. A study of a possible alternative to Nd:YAG was undertaken. Nd(3+) doped $LaBe_2O_5$ (Nd:BEL) was the material chosen. The research concentrated on relative performance parameters. The authors hoped to identify any glaring weaknesses of a material that could preclude its military use, or any significant strengths that would encourage its exploitation. To complement the data obtained, a brief discussion of spectroscopy, lasing levels, and other physical properties is included.

40652 **(AD-A—191178/3/XAB) Nonlinear wave propagation in free-electron lasers. Final scientific report, 1 July 1985-31 December 1986.** Colson, W.B. (Berkeley Research Associates, Inc., CA (USA)). 31 Dec 1986. 23p. (BRA—88-328R). NTIS, PC A03/MF A01.

An outline of new research results is given in the FEL klystron theory, exotic short-pulse evolution, optical guiding in the high-gain regime, fully four-dimensional simulations of the FEL, coherence development and line narrowing in the FEL, and a global map describing the trapped-particle instability and chaos regions in the free-electron laser. The description of the high-gain klystron FEL was improved. Previous work has assumed low-gain in the analysis of the high-gain klystron design. The gain of the klystron FEL in this research was calculated with use of the coupled, self-consistent Lorentz-Maxwell equations. For high gain, the objective of the klystron configuration, the gain spectrum is found to be modified from the previously known low-gain result. This is caused by the shifting of the optical phase during the gain process and is calculated for the first time. The effects derived are not obtainable from the Madey Theorem. The klystron saturation in strong nonlinear optical fields is also discussed. A comparison is made of the use of plasma theory and distribution functions, and the single-particle approach.

40653 **(AD-A—191361/5/XAB) Bibliography of Soviet laser developments, Number 75, January-February 1985.** (Defense Intelligence Agency, Washington, DC (USA). Directorate for Scientific and Technical Intelligence). May 1986. 166p. (DIA-DST—2700Z-003-86). NTIS, PC A08/MF A01.

This is the Soviet Laser Bibliography for January-February 1985, and is No. 75 in a continuing series on Soviet laser developments. The coverage includes basic research on solid-state, liquid, gas, and chemical lasers; components; nonlinear optics; spectroscopy of laser materials; ultrashort pulse generation; theoretical aspects of advanced lasers; and general laser theory. Laser applications are listed under biological effects; communications systems; beam propagation; adaptive optics; computer technology; holography; laser-induced chemical reactions; measurement of laser parameters; laser measurement applications; laser-excited optical effects; laser spectroscopy; beam-target interaction; and plasma generation and diagnostics.

40654 **(AD-A—191362/3/XAB) Bibliography of Soviet laser developments, Number 76, March-April 1985.** (Defense Intelligence Agency, Washington, DC (USA). Directorate for Scientific and Technical Intelligence). Jun 1986. 160p. (DIA-DST—2700Z-004-86). NTIS, PC A08/MF A01.

This is the Soviet Laser Bibliography for March-April 1985, and is No. 76 in a continuing series on Soviet laser developments. The coverage includes basic research on solid-state, liquid, gas, and chemical lasers; components; nonlinear optics; spectroscopy of laser materials; ultrashort pulse generation; theoretical aspects of advanced lasers; and general laser theory. Laser applications are listed under biological effects; communications systems; beam propaga-

tion; adaptive optics; computer technology; holography; laser-induced chemical reactions; measurement of laser parameters; laser measurement applications; laser-excited optical effects; laser spectroscopy; beam-target interaction; and plasma generation and diagnostics.

40655 **(AD-A—191363/1/XAB) Bibliography of Soviet laser developments, Number 77, May-June 1985.** (Defense Intelligence Agency, Washington, DC (USA). Directorate for Scientific and Technical Intelligence). Sep 1986. 133p. (DIA-DST—2700Z-005-86). NTIS, PC A07/MF A01.

This is the Soviet Laser Bibliography for May-June 1985, and is No. 77 in a continuing series on Soviet laser developments. The coverage includes basic research on solid-state, liquid, gas, and chemical lasers; components; nonlinear optics; spectroscopy of laser materials; ultrashort pulse generation; theoretical aspects of advanced lasers; and general laser theory. Laser applications are listed under biological effects; communications systems; beam propagation; adaptive optics; computer technology; holography; laser-induced chemical reactions; measurement of laser parameters; laser measurement applications; laser-excited optical effects; laser spectroscopy; beam-target interaction; and plasma generation and diagnostics.

40656 **(AD-A—191364/9/XAB) Bibliography of Soviet laser developments, Number 74, November-December 1984.** (Defense Intelligence Agency, Washington, DC (USA). Directorate for Scientific and Technical Intelligence). Sep 1986. 131p. (DIA-DST—2700Z-002-86). NTIS, PC A07/MF A01.

This is the Soviet Laser Bibliography for November-December 1984, and is No. 74 in a continuing series on Soviet laser developments. The coverage includes basic research on solid-state, liquid, gas, and chemical lasers; components; nonlinear optics; spectroscopy of laser materials; ultrashort pulse generation; theoretical aspects of advanced lasers; and general laser theory. Laser applications are listed under biological effects; communications systems; beam propagation; adaptive optics; computer technology; holography; laser-induced chemical reactions; measurement of laser parameters; laser measurement applications; laser-excited optical effects; laser spectroscopy; beam-target interaction; and plasma generation and diagnostics.

40657 **(AD-A—191365/6/XAB) Bibliography of Soviet laser developments, Number 73, September-October 1984.** (Defense Intelligence Agency, Washington, DC (USA). Directorate for Scientific and Technical Intelligence). Jan 1986. 133p. (DIA-DST—2700Z-001-86). NTIS, PC A07/MF A01.

This is the Soviet Laser Bibliography for September-October 1984, and is No. 73 in a continuing series on Soviet laser developments. The coverage includes basic research on solid-state, liquid, gas, and chemical lasers; components; nonlinear optics; spectroscopy of laser materials; ultrashort pulse generation; theoretical aspects of advanced lasers; and general laser theory. Laser applications are listed under biological effects; communications systems; beam propagation; adaptive optics; computer technology; holography; laser-induced chemical reactions; measurement of laser parameters; laser measurement applications; laser-excited optical effects; laser spectroscopy; beam-target interaction; and plasma generation and diagnostics.

40658 **(AD-A—191366/4/XAB) Bibliography of Soviet laser developments, Number 72, July-August 1984.** (Defense Intelligence Agency, Washington, DC (USA). Directorate for Scientific and Technical Intelligence). Nov 1985. 148p. (DIA-DST—2700Z-006-85). NTIS, PC A07/MF A01.

This is the Soviet Laser Bibliography for July-August 1984, and is No. 72 in a continuing series on Soviet laser developments. The coverage includes basic research on solid-state, liquid, gas, and chemical lasers; components; nonlinear optics; spectroscopy of laser materials; ultrashort pulse generation; theoretical aspects of advanced lasers; and general laser theory. Laser applications are listed under biological effects; communications systems; beam propagation; adaptive optics; computer technology; holography; laser-induced chemical reactions; measurement of laser parameters; laser measurement applications; laser-excited optical effects; laser spectroscopy; beam-target interaction; and plasma generation and diagnostics.

40659 **(AD-A—191367/2/XAB) Bibliography of Soviet laser developments. Number 71, May-June 1984.** (Defense Intelligence Agency, Washington, DC (USA). Directorate for Scientific and Technical Intelligence). Aug 1985. 112p. (DIA-DST—2700Z-005-85). NTIS, PC A06/MF A01.

This is the Soviet Laser Bibliography for May-June 1984, and is No. 71 in a continuing series on Soviet laser developments. The coverage includes basic research on solid-state, liquid, gas, and chemical lasers; components; nonlinear optics; spectroscopy of laser materials; ultrashort pulse generation; theoretical aspects of advanced lasers; and general laser theory. Laser applications are listed under biological effects; communications systems; beam propagation; adaptive optics; computer technology; holography; laser-induced chemical reactions; measurement of laser parameters; laser measurement applications; laser-excited optical effects; laser spectroscopy; beam-target interaction; and plasma generation and diagnostics.

40660 **(AD-A—191368/0/XAB) Bibliography of Soviet laser developments. Number 70, March-April 1984.** (Defense Intelligence Agency, Washington, DC (USA). Directorate for Scientific and Technical Intelligence). 12 Jun 1985. 143p. (DIA-DST—2700Z-004-85). NTIS, PC A07/MF A01.

This is the Soviet Laser Bibliography for March-April 1984, and is No. 70 in a continuing series on Soviet laser developments. The coverage includes basic research on solid-state, liquid, gas, and chemical lasers; components; nonlinear optics; spectroscopy of laser materials; ultrashort pulse generation; theoretical aspects of advanced lasers; and general laser theory. Laser applications are listed under biological effects; communications systems; beam propagation; adaptive optics; computer technology; holography; laser-induced chemical reactions; measurement of laser parameters; laser measurement applications; laser-excited optical effects; laser spectroscopy; beam-target interaction; and plasma generation and diagnostics.

40661 **(AD-A—191369/8/XAB) Bibliography of Soviet laser developments. Number 69, January-February 1984.** (Defense Intelligence Agency, Washington, DC (USA). Directorate for Scientific and Technical Intelligence). Jun 1985. 133p. (DIA-DST—2700Z-003-85). NTIS, PC A07/MF A01.

This is the Soviet Laser Bibliography for January-February 1984, and is No. 69 in a continuing series on Soviet laser developments. The coverage includes basic research on solid-state, liquid, gas, and chemical lasers; components; nonlinear optics; spectroscopy of laser materials; ultrashort pulse generation; theoretical aspects of advanced lasers; and general laser theory. Laser applications are listed under biological effects; communications systems; beam propagation; adaptive optics; computer technology; holography; laser-induced chemical reactions; measurement of laser parameters; laser measurement applications; laser-excited optical effects; laser spectroscopy; beam-target interaction; and plasma generation and diagnostics.

40662 **(AD-A—191370/6/XAB) Bibliography of Soviet laser developments, Number 79, September-October 1985.** (Defense Intelligence Agency, Washington, DC (USA). Directorate for Scientific and Technical Intelligence). Jan 1987. 130p. (DIA-DST—2700Z-002-87). NTIS, PC A07/MF A01.

This is the Soviet Laser Bibliography for September-October 1985, and is No. 79 in a continuing series on Soviet laser developments. The coverage includes basic research on solid-state, liquid, gas, and chemical lasers; components; nonlinear optics; spectroscopy of laser materials; ultrashort pulse generation; theoretical aspects of advanced lasers; and general laser theory. Laser applications are listed under biological effects; communications systems; beam propagation; adaptive optics; computer technology; holography; laser-induced chemical reactions; measurement of laser parameters; laser measurement applications; laser-excited optical effects; laser spec-

troscopy; beam-target interaction; and plasma generation and diagnostics.

40663 **(AD-A—191371/4/XAB) Bibliography of Soviet laser developments, Number 78, July-August 1985.** (Defense Intelligence Agency, Washington, DC (USA). Directorate for Scientific and Technical Intelligence). Dec 1986. 126p. (DIA-DST—2700Z-001-87). NTIS, PC A07/MF A01.

This is the Soviet Laser Bibliography for July-August 1985, and is No. 78 in a continuing series on Soviet laser developments. The coverage includes basic research on solid-state, liquid, gas, and chemical lasers; components; nonlinear optics; spectroscopy of laser materials; ultrashort pulse generation; theoretical aspects of advanced lasers; and general laser theory. Laser applications are listed under biological effects; communications systems; beam propagation; adaptive optics; computer technology; holography; laser-induced chemical reactions; measurement of laser parameters; laser measurement applications; laser-excited optical effects; laser spectroscopy; beam-target interaction; and plasma generation and diagnostics.

40664 **(AD-A—191372/2/XAB) Bibliography of Soviet laser developments, Number 80, November-December 1985.** (Defense Intelligence Agency, Washington, DC (USA). Directorate for Scientific and Technical Intelligence). Mar 1987. 128p. (DIA-DST—2700Z-003-87). NTIS, PC A07/MF A01.

This is the Soviet Laser Bibliography for November-December 1985, and is No. 80 in a continuing series on Soviet laser developments. The coverage includes basic research on solid-state, liquid, gas, and chemical lasers; components; nonlinear optics; spectroscopy of laser materials; ultrashort pulse generation; theoretical aspects of advanced lasers; and general laser theory. Laser applications are listed under biological effects; communications systems; beam propagation; adaptive optics; computer technology; holography; laser-induced chemical reactions; measurement of laser parameters; laser measurement applications; laser-excited optical effects; laser spectroscopy; beam-target interaction; and plasma generation and diagnostics.

40665 **(AD-A—191373/0/XAB) Bibliography of Soviet laser developments, Number 82, March-April 1986.** (Defense Intelligence Agency, Washington, DC (USA). Directorate for Scientific and Technical Intelligence). Aug 1987. 149p. (DIA-DST—2700Z-006-87). NTIS, PC A07/MF A01.

This is the Soviet Laser Bibliography for March-April 1986, and is No. 82 in a continuing series on Soviet laser developments. The coverage includes basic research on solid-state, liquid, gas, and chemical lasers; components; nonlinear optics; spectroscopy of laser materials; ultrashort pulse generation; theoretical aspects of advanced lasers; and general laser theory. Laser applications are listed under biological effects; communications systems; beam propagation; adaptive optics; computer technology; holography; laser-induced chemical reactions; measurement of laser parameters; laser measurement applications; laser-excited optical effects; laser spectroscopy; beam-target interaction; and plasma generation and diagnostics.

40666 **(AD-A—191374/8/XAB) Bibliography of Soviet laser developments, Number 83, May-June 1986.** (Defense Intelligence Agency, Washington, DC (USA). Directorate for Scientific and Technical Intelligence). Sep 1987. 133p. (DIA-DST—2700Z-007-87). NTIS, PC A07/MF A01.

This is the Soviet Laser Bibliography for May-June 1986, and is No. 83 in a continuing series on Soviet laser developments. The coverage includes basic research on solid-state, liquid, gas, and chemical lasers; components; nonlinear optics; spectroscopy of laser materials; ultrashort pulse generation; theoretical aspects of advanced lasers; and general laser theory. Laser applications are listed under biological effects; communications systems; beam propagation; adaptive optics; computer technology; holography; laser-induced chemical reactions; measurement of laser parameters; laser measurement applications; laser-excited optical effects; laser spectroscopy; beam-target interaction; and plasma generation and diagnostics.

40667 **(AD-A—191375/5/XAB) Bibliography of Soviet laser developments, Number 84, July-August 1986.** (Defense Intelligence Agency, Washington, DC (USA). Directorate for Scientific and Technical Intelligence). Oct 1987. 122p. (DIA-DST—2700Z-008-87). NTIS, PC A06/MF A01.

This is the Soviet Laser Bibliography for July-August 1986, and is No. 84 in a continuing series on Soviet laser developments. The coverage includes basic research on solid-state, liquid, gas, and chemical lasers; components; nonlinear optics; spectroscopy of laser materials; ultrashort pulse generation; crystal growing; theoretical aspects of advanced lasers; and general laser theory. Laser applications are listed under biological effects; communications systems; beam propagation; adaptive optics; computer technology; holography; laser-induced chemical reactions; measurement of laser parameters; laser measurement applications; laser-excited optical effects; laser spectroscopy; beam-target interaction; and plasma generation and diagnostics.

40668 **(AD-A—191376/3/XAB) Bibliography of Soviet laser developments, Number 85, September-October 1986.** (Defense Intelligence Agency, Washington, DC (USA). Directorate for Scientific and Technical Intelligence). Nov 1987. 130p. (DIA-DST—2700Z-009-87). NTIS, PC A07/MF A01.

This is the Soviet Laser Bibliography for September-October 1986, and is No. 85 in a continuing series on Soviet laser developments. The coverage includes basic research on solid-state, liquid, gas, and chemical lasers; components; nonlinear optics; spectroscopy of laser materials; ultrashort pulse generation; crystal growing; theoretical aspects of advanced lasers; and general laser theory. Laser applications are listed under biological effects; communications systems; beam propagation; adaptive optics; computer technology; holography; laser-induced chemical reactions; measurement of laser parameters; laser measurement applications; laser-excited optical effects; laser spectroscopy; beam-target interaction; and plasma generation and diagnostics.

40669 **(AD-A—191377/1/XAB) Bibliography of Soviet laser developments, Number 86, November-December 1986.** (Defense Intelligence Agency, Washington, DC (USA). Directorate for Scientific and Technical Intelligence). Dec 1987. 153p. (DIA-DST—2700Z-010-87). NTIS, PC A08/MF A01.

This is the Soviet Laser Bibliography for November-December 1986, and is No. 86 in a continuing series on Soviet laser developments. The coverage includes basic research on solid-state, liquid, gas, and chemical lasers; components; nonlinear optics; spectroscopy of laser materials; ultrashort pulse generation; crystal growing; theoretical aspects of advanced lasers; and general laser theory. Laser applications are listed under biological effects; communications systems; beam propagation; adaptive optics; computer technology; holography; laser-induced chemical reactions; measurement of laser parameters; laser measurement applications; laser-excited optical effects; laser spectroscopy; beam-target interaction; and plasma generation and diagnostics.

40670 **(AD-A—191425/8/XAB) Effects of translational and rotational nonequilibrium on c-w chemical-laser performance. Technical report.** Mirels, H. (Aerospace Corp., El Segundo, CA (USA). Aerophysics Lab.). 1 Mar 1988. 58p. (TR—0086A(2060)-1). NTIS, PC A04/MF A01.

A previous model used to describe continuous-wave (c-w) chemical laser performance is generalized to include rotational as well as translational nonequilibrium. The resultant equations are simplified by the realistic assumption that translational and rotational relaxation rates are fast compared with convection, chemical pumping, and collisional deactivation rates. As a consequence, translational and rotational relaxation rates are in equilibrium with stimulated emission. The resultant system of equations is independent of rotational relaxation. An amplifier solution is presented that predicts saturation effects in accord with experiments. Fabry-Perot oscillator solutions are also presented for a multiline saturated laser and for a partly saturated single-lien laser. These present results provide a base for simplification of numerical codes. It is concluded that a resonable first estimate for c-w chemical laser performance

can be obtained by assuming rotational equilibrium and translational nonequilibrium.

40671 **(AD-A—191980/2/XAB) Blue-green laser diode research program. Final technical progress report, 1 October 1985-31 December 1987.** Potts, J.E.; Mar, H.A.; Walker, C.T. (Minnesota Mining and Mfg. Co., St. Paul (USA). Electronic and Information Sector Labs.). Feb 1988. 92p. NTIS, PC A05/MF A01.

This report presents the results of work during the final quarter of ONR Contract No. N00014-85-C-0552 (July 1, 1987 to September 30, 1987) and during a three-month extension of the original twenty-four month program (October 1, 1987 to December 31, 1987). It concludes with a Summary Report describing the highlights and major accomplishments under this contract during the period October 1, 1985 to December 31, 1987 in the following areas: i. Growth of unintentionally-doped ZnSe epitaxial films by MBE on (100) GaAs substrates in order to fully characterize the material and to understand the effects of varying growth conditions on the resultant film properties; ii. Growth of unintentionally-doped ZnSe on alternate substrates (Ge, Si, Ge with Ge buffer layer, Si with Ge/ZnSe strained-layer superlattice buffer layer) in an attempt to reduce the deleterious effects caused by lattice mismatch between the substrate and the epilayer and/or possible autodoping by contaminants from the substrate which had been suspected to occur when using GaAs substrates; iii. p-doping of ZnSe films on (100) GaAs substrates; iv. Examination of the lasing properties of ZnSe films using electron-beam pumping; and v. Studies of metal contacts on ZnSe for Ohmic contacts and Schottky barriers.

40672 **(PB—88-194758/XAB) Development of an XeCl laser with an average 100-w power output. Final report.** Delaporte, P.; Fontaine, B.; Forestier, B.; Sentis, M. (Aix-Marseille-1 Univ., 13 - Marseille (France)). Nov 1987. 79p. (In French). NTIS, PC E05/MF E05.

Text in French, portion in English. See also PB—88-139241.

The research deals with the limiting phenomena involved in the development of an XeCl excimer laser with a high average power output of 100 W. The objective was to model laser kinetics, and to achieve a better understanding of the aerodynamic waves induced through gas excitation and of the effect of wave coupling on laser characteristics. With help from the DRET (Directorate of Research, Studies and Technology), expertise was acquired; it should prove useful in the context of the Eureka program and promote French participation in the development of the future European laser.

40673 **(PB—88-196910/XAB) 1.3-(Mu)m wavelength BDC structure DFB semiconductor laser.** Uno, T.; Morisaki, M.; Ban, Y.; Serizawa, H. (Matsushita Electric Industrial Co. Ltd., Moriguchi (Japan)). 1988. 8p. NTIS, PC E06/MF A01.

Text in Japanese; Included in National Technical Report, Vol. 34, No. 1, 4-10(Feb 1988).

A new InGaAsP/InP distributed feedback laser, named Buried Double Channel structure DFB laser (BDC-DFB-LD), was developed by using the LPE (liquid phase epitaxy) and MOVPE (metal organic vapor phase epitaxy) hybrid epitaxial growth technique. The BDC structure makes possible simultaneous formation of cladding layers and current confinement layers. By the use of the MOVPE epitaxial-growth technique, a uniform corrugation shape and a uniform layer thickness were obtained in a 20x30 sq mm wafer. As a result, an average threshold current of as low as 22.4 mA with a small standard deviation of 2.5 mA was obtained for 100 chips randomly chosen from a wafer. High-temperature operation up to 100 C and high-power operation up to 35 mW at 20 C were attained with a side-mode suppression ratio of more than 30 dB.

40674 **(PB—88-196928/XAB) 1.3-(Mu)m internal-reflection-interference semiconductor laser.** Tsuruta, T.; Negishi, H.; Idota, K.; Hirayama, N.; Matsuki, M. (Matsushita Electric Industrial Co. Ltd., Moriguchi (Japan)). 1988. 10p. NTIS, PC E06/MF A01.

Text in Japanese; Included in National Technical Report, Vol. 34, No. 1, 11-19(Feb 1988).

A stable longitudinal-mode 1.3-micrometer laser diode with internal mirrors in its waveguide was developed. It is called an internal-reflection-interference buried crescent laser with semi-insulating layer (IRI-BCSI-LD). The internal mirrors are fabricated using an anisotropic etching technique, which allows precise control (+ or - 1 micrometer) of the mirror-to-mirror distance. A typical threshold current of 30 mA and a sub-mode suppression ratio (SMSR) of 20 dB are reproducibly obtained. The IRI-BCSI-LDs are coupled to single-mode fibers through two confocal lenses, forming LD modules. The modules have a maximum SMSR of 20 dB, and a temperature dependence of lasing wavelength of as small as 0.9A/deg C in the range from 15 to 40 deg C. Experiments suggest that the modules are feasible in high-bit-rate digital transmission systems.

40675 **(PB—88-204755/XAB) Study of transition ion- and rare earth ion- based infra-red laser materials. Final report and appendix.** Boulon, G.; Moncorge, R.; Pedrini, C. (Lyon-1 Univ., 69 (France)). 1988. 219p. (In French). NTIS, PC E10/MF E10.

The object of the research was to study the optical properties of materials producing or capable of producing a tunable laser effect between 1 and 2 micrometers, and to optimize the operating conditions of these systems (doped mixed fluorides or oxides, Ni(2+), CO(2+) or Ho(3+)). The authors analyzed in detail the dynamics of the excited states of Er(3+) and Ho(3+) in YLiF, and understand them perfectly. This is the first time such a systematic study has been made of this system, and the results lead to important deductions on doping ion concentrations, depending on the luminous excitation considered.

40676 **(PPPL—2516) High power picosecond laser system at 248 nm.** Tighe, W.; Nam, C.H.; Robinson, J.; Suckewer, S. (Princeton Univ., NJ (USA). Plasma Physics Lab.). May 1988. Contract AC02-76CH03073. 22p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88011871/JAW.

We describe a powerful picosecond KrF* laser system consisting of a synchronously pumped dye oscillator, a three-stage dye amplifier, frequency conversion to 248 nm, and amplification through a series of excimer modules. Characteristics are given at each stage of the system. Initital visible spectra obtained by interaction with various targets are presented. Future plans are indicated. 18 refs., 8 figs.

40677 **(UCRL—96712) Transverse resistive wall instability in a high-power, short-wavelength free-electron laser.** Neil, V.K.; Whittum, D.H. (Lawrence Livermore National Lab., CA (USA); Lawrence Berkeley Lab., CA (USA)). 1987. Contract W-7405-ENG-48. 24p. (CONF-8709110—24). NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88011730/JAW.

From 9. international free-electron laser conference; Williamsburg, VA, USA (14 Sep 1987).

The finite resistivity in walls surrounding a beam of charged particles can lead to unstable, coherent, transverse motion of the beam. For a beam pipe of circular cross sections and radius b, the amplitude of the transverse motion grows exponentially with an e-folding length inversely proportional to the beam current and directly proportional to b^2 or b^3, depending on the parameter regime. In conventional accelerators and beam transport systems, b is at least a few centimeters, and the growth length is quite long. In a free-electron laser (FEL) wiggler magnet, we must have b < λ/sub w//2π, with λ/sub w/ the wiggler wavelength, so that b may be only a few millimeters. We treat a 20-m-long wiggler of an FEL amplifier driven by an induction linac. Results indicate the instability is of no consequence for the oscillator but does impose lower limits on the pipe radius for the amplifier. 6 refs., 4 figs., 2 tabs.

40678 **(UCRL—96753) Model for pulse amplification by a gaseous laser amplifier.** Boley, C.D.; Warner, B.E. (Lawrence Livermore National Lab., CA (USA)). 19 Oct 1987. Contract W-7405-ENG-48. 12p. (CONF-871047—1). NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88011729/JAW.

From Optical Society of America annual meeting; Rochester, NY, USA (18 Oct 1987).

We have developed a computational model for pulse amplification by a pulsed electric discharge laser amplifier. We have applied the model to the copper vapor system, for which the oscillator has previously been modeled on a 0-D level and a 1-D level. The laser intensity transport equations are set up on a ray and are differenced with respect to the axial coordinate. Amplified spontaneous emission is handled similarly. Rate equations for the atomic levels are set up in each axial cell. The motion of the atoms is negligible on the nanosecond time scales of interest. The entire system of equations is advanced in time by a standard mathematical package. Working with a selection of input pulse shapes and energies, we have obtained predictions for the amplified signal as a function of time. We have also obtained results for related diagnostics such as the radiation profiles along the tube at selected times.

40679 **Strengthened phosphate glass in a high rep rate active-mirror amplifier geometry.** Cerqua, K.A.; Shoup M.J. III; Smith, D.L.; Jacobs, S.D.; Kelly, J.H. (University of Rochester, Laboratory for Laser Energetics, Rochester, New York 14623-1299). *Applied Optics;* 27: No. 12, 2567-2572(15 Jun 1988).

Ion-exchange strengthened phosphate glass in an active-mirror geometry remained unfractured at pump power levels 3 times the average pump fracture limit of unstrengthened phosphate glass in the same geometry. In addition, pretreatment and posttreatment measurements of surface wavefront and roughness were made on a set of rectangular substrates to quantify any ion-exchange-induced surface modifications. Experimental measurements of treatment-induced wavefront deformation of strengthened blocks were shown to be less than modeled values of distortion attributable to extended treatment times.

40680 **Free-electron lasers; Proceedings of the Meeting, Los Angeles, CA, Jan. 15, 16, 1987.** Newnam, B.E. Bellingham, WA; Society of Photo-Optical Instrumentation Engineers (1988). 183p. (CONF-8701134—).

From Free-electron lasers; Los Angeles, CA, USA (15 Jan 1987).

The present conference discusses fundamental FEL theory and novel principles for advanced devices, electrostatic accelerator-based FELs, storage ring-driven FELs, high-power FEL optical cavities, and powerful mm-wave FELs driven by high-current, MeV accelerators. Also discussed are the development status of a Cerenkov FEL, RF-linac FELs, sideband generation and mode structure in FELs, optical guiding and beam-bending in FELs, the development status and future prospects of induction linac-driven FELs, FEL electron beam diagnostics, and the extension of FEL operation into the EUV.

40681 **Process design and evaluation of a continuous chemical plant for the singlet oxygen-iodine laser.** Demyanovich, R.J.; Lynn, S. (TERA Corp., 2150 Shattuck Avenue, Berkeley, CA (US)). *Fusion Technology;* 12: No. 3, 488-501(Nov 1987).

Process designs were evaluated for the continuous, large-scale generation singlet delta oxygen for use in a chemical oxygen-iodine laser. The excited singlet oxygen is generated from the chemical reaction of chlorine gas with basic hydrogen peroxide. The chemical reaction also produces a large waste brine stream that can be controlled by recycling through a chloralkali cell, which regenerates the reactants Cl/sub 2/ and NaOH. To prevent deactivation of this excited oxygen, a large excess of hydrogen peroxide is typically used to change the reaction mechanism. This use of excess hydrogen peroxide or nonstoichiometric generation leads to substantial increases in capital and operating costs when compared with theoretical stoichiometric (no excess) generation. For the generation of singlet oxygen at a 500-kW level of equivalent lasing power, a theoretical stoichiometric plant producing all reactants has an estimated capital cost of $38 million. The capital cost for a nonstoichiometric plant is $98 million. Operating costs are $0.68 and $2.12/lb of singlet oxygen, respectively. The energy efficiency of generation is —6.3% for the theoretical stoichiometric flow sheet and 3.3% for the nonstoichiometric flow sheet. At this nonstoichiometric efficiency, the use of a chemical oxygen iodine laser for photoneutralization of negative ion beams is probably not competitive with other technologies below a 750-keV neutral beam level.

40682 **Dynamic and spectral properties of semiconductor lasers with quantum well, quantum wire, and quantum box structures.** Arakawa, Y. Tokyo, Japan; Tokyo University (1987). vp.

Dynamic and spectral properties of semiconductor lasers having quantum-mechanical microstructures are discussed with emphasis on the quantum box lasers. The theoretical analysis indicates that laser characteristics are significantly improved in low-dimensional electronic gas systems. In order to demonstrate the quantum box effects experimentally, a quantum well laser was placed in a high magnetic field, in which zero-dimensional electronic systems are formed by both Lorentz force and the quantum well potential effects. In addition, recent progress of picosecond pulse generation in quantum well lasers is also discussed. This presentation is represented by viewgraphs only.

40683 **Ultrahigh coherent semiconductor lasers and their applications to Rb atomic clock.** Ohtsu, M.; Kuboki, K.; Hashimoto, M. Yokahama, Japan; Tokyo Institute of Technology (1987). vp.

It was demonstrated that the FM noise in semiconductor lasers can be reduced to a value lower than the quantum noise limit by using negative electrical feedback. A synthesized method of electrical feedback is proposed to realize such ultrahigh temporal coherence in semiconductor lasers. As an alternative scheme to realize such ultrahigh coherence in semiconductor lasers, an experimental method for accurate frequency tracking using the correlated spontaneous emission between the two longitudinal modes was presented. A method of resonant coupling between the two optical transitions are employed via optical sidebands produced by parametric modulation of the laser gain. By this modulation, the linewidth of the heterodyned signal was reduced to 25 kHz. The value corresponds to suppression of the relative phase noise to less than one-twentieth of the quantum noise limit of the free-running laser. As an application of these ultrahigh coherent lasers, the lasers were used as optical pumping sources for Rb atomic clock of 6.8 GHz frequency. An optical microwave double resonance spectral shape with the linewidth as narrow as 20 Hz is demonstrated by utilizing FM sidebands of the laser induced by nonlinear susceptibility of the three-level Rb atoms. This presentation is represented by viewgraphs only.

40684 **Squeezed state in degenerate parametric amplification discussed by H. Takahasi in 1963.** Shimoda, K. Yokahama, Japan; Keio University (1987). vp.

A theory of quantum noise was developed by Professor Hidetosi Takahasi by appropriately applying the quantum mechanics to a general theory of communication channels. The quantum-mechanical coherent state of a harmonic oscillator is discussed, and a quantum theory of parametric amplifiers, in which the squeezed state in degenerate parametric conversion was particularly emphasized, was subsequently developed. This presentation is represented by viewgraphs only.

40685 **Squeezed states of light.** Kimble, H.J.; Brecha, R.J.; Orozco, L.A.; Raizen, M.G.; Wu, L.A.; Xiao, M. Austin, TX; Texas University (1987). vp.

In the laboratory squeezed states of light were generated in two distinct physical systems. The first experiment investigates squeezing for two level atoms coupled to the intracavity field of a high quality optical resonator. For large coupling of the atoms to the cavity field, there is a mode splitting in the eigenvalue structure of the system analogous to the splitting found when two otherwise independent pendulums are coupled by a spring. The coupling-induced structure of the composite system was employed to generate squeezing. The second experiment involves the process of degenerate parametric down conversion in which a photon of frequency 2 omega is split into a correlated pair of photons at the subharmonic frequency omega. While noise reductions of greater than 60 percent were observed relative to the vacuum-state limit, a quantitative analysis of the various propagation and detection losses in the current apparatus indicates that the field would in fact be squeezed more than ten-fold in the absence of these losses. Quite recently use was made of the squeezed light to demonstrate that precision measurements can be made with a sensitivity greater than that given by

the vacuum-state or shot-noise limit. This presentation is represented by abstracts only.

40686 **Pulsed squeezed light.** Slusher, R.E. Murray Hill, NJ; Bell Telephone Labs., Inc. (1987). vp.

Generation of interesting quantum states of light, including squeezed states and number states, requires a large nonlinear interaction. An extension of standard generation and homodyne detection experimental techniques to the pulsed case is described. It is expected that by using mode-locked pulse trains as the pump laser and a portion of the pulse train as the local oscillator for the homodyne detector that corresponds to generation by the peak laser pump intensity in the pulse train. Viewgraphs 3 through 6 describe the analysis of pulsed squeezing. Viewgraphs 7 and 8 describe a pulsed LO homodyne detector which is working at present. This presentation is represented by viewgraphs.

40687 **Quantum nondemolition detection and squeezing in optical fibers.** Levenson, M.D.; Shelby, R.M.; Perimutter, S.H. San Jose, CA; International Business Machines Corp. (1987). vp.

The nonlinear optical interactions in an optical fiber permit the amplitude of one wave to be inferred from the phase of a coupled wave, and the partial suppression of quantum noise. This process was termed Quantum Nondemolition Detection (QND) or Back Action Evading Measurement. The QND readout was correlated with a subsequent quantum demotion detection (QDD) measurement of the QND variable. Back action evasion was demonstrated by showing that the QND variable at the output of the detector has no greater noise than at the input (which was at the vacuum noise level). When the correlated noise on two coupled laser beams is made to subtract coherently, the net noise level can be below the vacuum noise level. This effect was termed four-mode squeezing since the fluctuations involve two sidebands of each of two strong pump waves. This presentation is represented by viewgraphs only.

40688 **Generation of number-phase minimum uncertainty states.** Yamamoto, Y.; Machida, S.; Imoto, N.; Kitagawa, M.; Bjoerk, G. Tokyo, Japan; Nippon Telegraph and Telephone Public Corporation (1987). vp.

The difference between the two nonclassical lights, i.e., the squeezed state and number-phase minimum uncertainty state (NUS) is discussed. The four different generation principles for NUS are described. They are: unitary evolution using self-phase modulation; nonunitary state reduction by the first kind measurement; controlled state reduction by quantum correlation measurement-feedback, and high saturated laser oscillation with suppressed-pump-noise. The constant current-driven semiconductor laser based on the last principle generated the NUS with photon number noise reduced below the standard quantum limit by 40 percent in the entire frequency region from dc to 1.1 GHz. Several applications of NUS including quantum communication, quantum mechanical computers and interferometric gravitational detection are discussed briefly. This presentation is represented by viewgraphs only.

40689 **Squeezing via travelling-wave forward four-wave mixing in atomic vapors: comparison with nondegenerate theory.** Kumar, P. Evanston, IL; Northwestern University (1987). vp.

Recent observations of 4 percent squeezing via travelling-wave forward four-wave mixing in sodium vapor are in good agreement with the quantum theory of nondegenerate multiwave mixing. Squeezing spectra for the parameter values employed in the Maeda experiment are presented. It is shown that for the available dye-laser power, as much as a factor of four squeezing should be achievable from about 50 to 700 MHz in the sodium vapor experiment. However, Doppler broadening, optical pumping, and self-focusing effects may limit the observable squeezing.

40690 **What has been done and what will be done by sub-natural linewidth spectroscopy.** Takuma, H.; Shimizu, K.; Shimizu, F. Tokyo, Japan; University of Electro-Communications (1987). vp.

Reduction of linewidth is an essential approach in high resolution spectroscopy. Several methods to remove or reduce inhomogeneous linewidth were developed resulting in a drastic improvement in the high resolution capability of laser spectroscopy. On the other hand, application of lasers was not very effective in reducing homogeneous linewidth. Main causes of the homogeneous line broadening in gaseous media are pressure broadening, saturation broadening, limited interaction time (transit time in the atomic/molecular beam spectroscopy), and natural width. Among those, the first and second ones are easily removed or reduced. The third one can be reduced by the use of recently developed laser cooling techniques. Thus the present discussion will be concentrating on the last one: reduction of the natural linewidth. This presentation is representated by viewgraphs.

40691 **Comprehensive model for laser instability in a CO_2 laser with gaseous saturable absorber.** Shimizu, T.; Tachikawa, M.; Tanii, K. Tokyo, Japan; Tokyo University (1987). vp.

A periodic self-pulsation well known as passive Q-switching (PQS) is observed in a CO_2 laser containing a gaseous saturable absorber inside its cavity. The PQS was developed as a high power pulse source to pump far-infrared lasers. In response to the recent interest in laser instability, it is now being investigated extensively. Dynamic properties of the relating molecular systems are sensitively reflected in the transient pulse structure, and various features of PQS pulsation are realized, depending on lasing conditions and characteristics of the absorbing molecules. So far, inspite of extensive efforts to analyze the PQS behavior, there is no good model which reproduces the observed pulse structure with fidelity. Through the numerical integration of the rate equations systematic reproduction of all the PQS pulses, especially the PQS pulse with the undamped undulation was accomplished. The undulation was revealed as a relaxation oscillation induced by the relaxation of the lower laser level. The model also describes optical bistability observed in the present laser system. The computer calculation based on the present model shows that chaotic pulsation is realized led by the period-doubling route. This is the first demonstration of chaos in a laser containing a saturable absorber. The present analysis suggests that it is possible by introducing saturable absorbers inside the cavity to observe chaos even in small-gain lasers such as CO_2 and N_2O lasers far from the bad-cavity condition. This presentation is represented by viewgraphs.

40692 **Recent progress in optical bistability and tristability.** Yabuzaki, T.; Kitano, M. Kyoto, Japan; Kyoto University (1987). vp.

In recent years optical bistability and tristability were studied theoretically and experimentally, and related phenomena such as self-pulsing, chaos, and transient chaos. The focus is on optical bistability, which is caused by the spin polarization in the presence of optical feedback. This bistability is considerably different from the ordinary one, because it has no hysteresis cycle, while it does have a pitchfork bifurcation, i.e., symmetry-breaking. The self-switching of the light polarization by spin-procession, which takes place in the same optical system is discussed. Finally, the multistability observed experimentally is discussed using simplified models with coupling between spatial nodes of light. This presentation is represented by viewgraphs.

40693 **Nonclassical lights.** Yuen, H.P. Evanston, IL; Northwestern University (1987). vp.

The differences between nonclassical lights and coherent-state lights are reviewed. Some general observations are made concerning the generation, propagation, and detection of squeezed-state and near number-state lights. The role of phase-sensitive linear amplifiers and photo-number amplifiers is emphasized. Certain possible applications of nonclassical lights to communications are described, including optic nerve local area networks. This presentation is represented by viewgraphs.

40694 **Design of the backscatter spectroscopy system for the Nova laser facility.** Tietbohl, G.L.; Drake, R.P.; Young, P.E. (Univ. of California, Lawrence Livermore National Lab., P.O. Box 5508, Livermore, CA (US)). pp 1551 of Proceedings of the 12th symposium on fusion engineering. Piscataway, NJ; IEEE Service Center (1987). (CONF-871007—).

From 12. symposium on fusion engineering; Monterey, CA, USA (12 Oct 1987).

The Nova laser facility at Lawrence Livermore National Laboratory performs experiments in pursuit of laser fusion and explores the physics of high-energy-density plasmas. When the laser light is focused onto a target, a number of mechanisms can reflect or scatter the light back through the focus lens. The Backscatter Spectroscopy System (BSS) is a diagnostic that measures the properties of this reflected for scattered light. Just before the main focus lens on each of the ten Nova arms is a KDP crystal array for converting the 1 μm laser light to shorter harmonic wavelengths. This array rotates —10° about the beams axis to select the 351 nm wavelengths where most of the experiments are run. The BSS consists of a fused silica plate inserted into one of the beam lines before the KDP array. The reflector plate is shaped like one of the array elements and is aligned with it to minimize the effects of diffraction. The plate is mounted in a mechanism to allow alignment as well as rotation with the KDP array when the converted wavelength is changed. The plate is mounted 10° off normal so that light can be reflected out of the beam tube. Roughly 4 percent of target-reflected light reflects off this plate and is transported to an optics table where it is analyzed. To transport the light to the optics table, an alignment insensitive relay lens system is used with a vacuum cell and turning mirrors. The instrumentation on the table includes a 0.5 meter spectrometer with an optical streak camera for time-resolved spectral information, a small photodiode array for intensity data, and a film pack for beam structure and system alignment information.

4204 Heat Transfer And Fluid Flow

REFER ALSO TO CITATION(S) 39381, 39472, 39547, 39688, 39689, 39690, 39697, 39698, 39699, 39740, 39749, 39850, 39851, 40132, 40469, 40510, 41618, 41627

40695 (AD-A—190897/9/XAB) Fast algorithms for Euler and Navier-Stokes simulations. Final report, 1 January-30 September 1987. Johnson, G.M. (Institute for Scientific Computing, Fort Collins, CO (USA)). 30 Nov 1987. 15p. NTIS, PC A03/MF A01.

An explicit flow solver, applicable to the hierarchy of model equations ranging from Euler to full Navier-Stokes, was combined with several techniques designed to reduce computational expense. The computational domain consisted of local grid refinements embedded in a global coarse mesh, where the locations of these refinements are defined by the physics of the flow. Flow characteristics were also used to determine which set of model equations is appropriate for solution in each region, thereby reducing not only the number of grid points at which the solution must be obtained, but also the computational effort required to get that solution. Acceleration to steady-state was achieved by applying multigrid on each of the subgrids, regardless of the particular model equations being solved. Since each of these components is explicit, advantage could readily be taken of the vector- and parallel-processing capabilities of machines such as the Cray X-MP and Cray 2.

40696 (AD-A—191191/6/XAB) Noncondensing round turbulent gas jets in liquids. Interim report, 1 August 1985-30 September 1987. Loth, E.; Faeth, G.M. (Michigan Univ., Ann Arbor (USA). Dept. of Aerospace Engineering). Oct 1987. 69p. NTIS, PC A04/MF A01.

The structure and mixing properties of noncondensing round turbulent air jets in still water was investigated experimentally, considering both subsonic and sonic underexpanded (with underexpanded ratios up to 8:1) jet-exit conditions. Measurements included flow visualization, using flash and high-speed motion-picture photography; mean void fraction distributions, using deconvoluted gamma-ray absorption measurements; mean entrainment velocities, using laser-Doppler anemometry; and mean static pressures along the axis, using a static-pressure probe. Analysis was also undertaken to help interpret the measurements, based on the locally homogeneous-flow approximation (relative velocity differences between the phases neglected) and an effective-adapted-jet approximation for treating the mixing properties of the underexpanded jets.

40697 (AD-A—192063/6/XAB) Noise generation by air bubbles in water: an experimental study of creation and splitting. Project report. Frizell, K.W.; Arndt, R.E. (Minnesota Univ., Minneapolis (USA). St. Anthony Falls Hydraulic Lab.). Dec 1987. 60p. NTIS, PC A04/MF A01.

Although the study of two-phase flow, especially air-water mixtures, has received much attention in recent years, little has been done concerning the noise generated by non-cavitating air-water flows. The main purpose of this work is to examine these flows; in particular, to look at the noise associated with the creation of air bubbles at a nozzle, and the noise radiated by air bubbles splitting in the shear layer of a submerged turbulent water jet. Experiments were conducted to measure the sound pressure levels associated with bubble creation and bubble splitting, under a variety of conditions. Comparisons were made with existing theories. An improved physical understanding of the mechanism of noise generation was gained through data analysis and photographic studies. Recommendations for further research are given.

40698 (AD-A—192215/2/XAB) Adaptive local-grid refinement in computational fluid mechanics. Final report, 1 April 1985-30 September 1987. Ewing, R.E.; Allen, M.B.; Djomehri, M.J.; George, J.H.; Isaacson, E.L. (Wyoming Univ., Laramie (USA)). Nov 1987. 19p. NTIS, PC A03/MF A01.

Several promising new techniques for efficient and accurate numerical solution of large-scale fluid-flow problems were developed. These methods include self-adaptive mesh-modification techniques for applications requiring front-tracking and local-grid refinement as well as new preconditioning ideas for efficient implementation. Properties of systems of hyperbolic conservation laws were obtained which will aid in development of accurate front-tracking algorithms. Adaptive grid-refinement techniques developed include moving-grid methods, local, fixed refinement involving linked-list data structures, and certain local-patch refinement ideas that have great potential for ease of implementation in existing large-scale codes. Domain decomposition concepts for obtaining efficient preconditioners for iterative techniques have proved quite useful both for local-patch refinement and for the solution of problems with rapidly varying coefficients. The fast adaptive algorithms being developed have high potential for both parallelization and vectorization. The algorithms have been designed to take advantage of the emerging parallel and vector-oriented computer architectures. Finally, the incorporation of these fast algorithms in accurate finite-element, collocation, and finite difference methods is underway.

40699 (CEA-R—10697) Computer code SEURBNUK/EURDYN Part. 2: input and output specifications. Yerkess, A.; Broadhouse, B.J.; Smith, B.L. (Commission of the European Communities, Luxembourg). 1987. 143p. NTIS (US Sales Only), PC A07/MF A01. Order Number DE88752453/JAW.

SEURBNUK-2 is a two-dimensional, axisymmetric, Eulerian, finite difference containment code. The numerical procedure adopted in SEURBNUK to solve the hydrodynamic equations is based on the semi-implicit ICE method which itself is an extension of the MAC algorithm. SEURBNUK has a finite difference thin shell treatment for vessels and internal structures of arbitrary shape and includes the effects of the compressibility of the fluid. Fluid flow through porous media and porous structures can also be accommodated. SEURBNUK/EURDYN is an extension of SEURBNUK-2 in which the finite difference thin shell treatment is replaced by a finite element calculation for both thin or thick structures. This has been achieved by coupling the shell elements and axisymmetric triangular elements. Within the code, the equations of motion for the structures are solved quite separately from those for the fluid, and the timestep for the fluid can be an integer multiple of that for the structures. The interaction of the structures with the fluid is then considered as a modification to the coefficients in the pressure equations, the modifications naturally depending on the behaviour of the structures within the fluid cell. The code is limited to dealing with a single fluid, the coolant, and the bubble and the cover gas are treated as cavities of uniform pressure calculated via appropriate pressure-volume-energy relationships. This manual de-

scribes the input data specifications needed for the execution of SEURBNUK/EURDYN calculations. After explaining the output facilities information is included to aid users to avoid some common pit-falls.

40700 **(DFVLR-FB—88-08) Investigation of annular flow at high evaporation rates in view of liquid film cooling.** Nahstoll, J. (Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt e.V., Koeln (Germany, F.R.); Kaiserslautern Univ. (Germany, F.R.). Fachbereich Maschinenwesen). 1988. 117p. (In German). NTIS (US Sales Only), PC A06. Order Number DE88754002/JAW.

The process of liquid film cooling of combustion chamber walls which are subjected to extremely high heat rates was investigated. A theoretical model has been developed for a reliable prediction of the film cooling length. The mass transfer at the liquid-gas interface results from evaporated liquid and entrained liquid droplets. The film cooling length analysis, which includes the physical effects in detail, is separated into two regions: heating the liquid and evaporating the liquid. The theoretical results were experimentally verified at high pressures and temperatures using a modified H/sub 2//O/sub 2/-rocket motor. There is a good agreement between the theoretical and the experimental results over the experimental range. (orig.) With 52 figs., 3 tabs., 71 refs.

40701 **(DOE/OR/00033—T403) Effects of interfacial structure on film condensation.** Barry, J.J. (Wisconsin Univ., Madison (USA)). 1987. Contract AC05-76OR00033. 261p. NTIS, PC A13/MF A01;1; GPO Dep. Order Number DE88009035/JAW.

Film condensation in the presence of a noncondensable gas is expected to be strongly affected by the presence of interfacial structure. An experimental program was undertaken to simultaneously measure a set of parameters for the interfacial waves and the condensation heat transfer coefficient. An isothermal air-water series was conducted in which air was blown over a flowing film. The experimental techniques for wave characterization were developed during these tests. Film thickness and wave amplitude, frequency, and celerity were measured. Two sets of heated tests were conducted. The first set utilized an injected film. Film and wave parameters were measured using the methods developed in the isothermal runs. The data showed an apparent suppression of the waves by the bulk flow of steam to the interface as was anticipated.

40702 **(DOE/PC/80511—T11) On fluctuating motions due to surface waves in gas fluidized beds.** Sun, J.G.; Chen, M.M.; Chao, B.T. (Illinois Univ., Urbana (USA). Dept. of Mechanical and Industrial Engineering). Jun 1988. Contract FG22-85PC80511. 35p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88011925/JAW.

It is the purpose of this communication to propose that a significant fraction of the fluctuations in a non-slugging bed may be associated with bed sloshing, or standing waves of the bed surface, excited by either random or coherent density fluctuations. Data on statistical properties of the fluctuations, including the frequency spectrum, will be presented to support this proposed mechanism. It will also be shown that all reported fluctuation data in the literature are also consistent with the mechanism. Conditions under which this mechanism and other previously proposed mechanisms may be appropriate will also be discussed. 31 refs., 8 figs.

40703 **(DOE/PC/80511—T12) Hydrodynamics, mixing, and segregation in gas fluidized beds: Technical progress report, 22 January 1988-21 April 1988.** Chen, M.M.; Chao, B.T. (Illinois Univ., Urbana (USA). Dept. of Mechanical and Industrial Engineering). 1988. Contract FG22-85PC80511. 14p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88011924/JAW.

Gas fluidized beds are being investigated. Efforts during this period have been focussed on derivation of an asymptotic theory of fluidization and on the continuation of the theoretical analysis of the gas mediated heat transfer to immersed surfaces due to particle impact. 1 ref., 3 figs.

40704 **(IC—88/10) On hydromagnetic channel flow induced by tooth pulses.** Bestman, A.R.; Njoku, F.I. (International Centre for Theoretical Physics, Trieste (Italy); International School of Advanced Studies, Trieste (Italy)). (International Centre for Theoretical Physics, Trieste (Italy)). Jan 1988. 12p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703031/JAW.

The paper considers unsteady hydromagnetic flow in a channel when the induced magnetic field is not necessarily negligible. The unsteadiness is sustained by velocity tooth pulses applied at one wall of the channel. The skin friction at the wall is compared with the situation when the induced magnetic field is neglected. (author). 3 refs, 2 tabs.

40705 **(IEN-DITRE—06/87) Modifications in the Teach-C computer code for convection analysis-two-dimensional transient diffusion.** Sampaio, P.A.B. de. (Instituto de Engenharia Nuclear, Rio de Janeiro (Brazil)). Aug 1987. 41p. (In Portuguese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88701579/JAW.

Some modifications in Teach-C computer program to analyse the heat conduction with convective heat transport are presented. The utilization of the program to solve a convective - diffusion problem is studied and the results are compared with an analysis of the same problem, in steady - state conditions, by finite element method.

40706 **(INIS-BR—957) Development of an experimental apparatus for nucleate boiling analysis.** Castro, A.J.A. de. (Pontificia Univ. Catolica do Rio de Janeiro (Brazil)). 1984. 147p. (In Portuguese). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88701611/JAW.

An experimental apparatus is developed for the study of the parameters that affect nucleate boiling. The experimental set up is tested for nucleate boiling in an annular test section with subcooled water flow. The following parameters are analysed: pressure, fluid velocity and the fluid temperature at the test section entrance. The performance of the experimental apparatus is analysed by the results and by the problems raised by the operation of the setup.

40707 **(INIS-mf—11640) 2D/3D-Project. Final report on the analysis of the 'advanced instrumentation'.** Hampel, G.; Bareiss, M.; Siefart, E.; Froehlich, H. (Battelle-Institut e.V., Frankfurt am Main (Germany, F.R.)). Dec 1985. 128p. (In German). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88752654/JAW.

Detailed analyses concerned the evaluation models of the pipe flowmeter, which will be used for two-phase mass flow measurements in the primary loops of the 3D test facility UPTF. These analyses as well as comparisons with the measurement and evaluation methods applied in the German HDR experiment have shown that for many experimental conditions the use of relatively simple weighting models will furnish results of almost the same quality as the use of heterogeneous models which are difficult to derive in practice with respect to selection criteria during the transient processes. The results of the extensive calibration experiments of the SCTF-pipe flowmeter performed at INEL cannot be transferred to UPTF. As to the intended development of a method of comparing measurements and code calculations of the UPTF results, two sample cases were modelled, which required on the one hand a TRAC result and on the other hand a measuring signal as reference value. In the course of further considerations on this subject, it was concluded that three-dimensional flow phenomena do not always require a time- and space-related comparison but that often, and especially in order to provide a quick overview, it appears sufficient to compare essential flow characteristics which are determinative for the experimental course. The correlation technique and other statistical methods were applied and further developed for the classification of experimental transients. The high potential of these methods is shown by the results so far obtained in tests using calculational results, e.g. the identification of time and space ranges that are characterised by specific flow regimes. Before these methods can be applied to the multidimensional UPTF experiments, further development work will be necessary which covers especially the consideration of measurement errors and signal scattering as well as

the automatic determination of time intervals that are typical of the experiment.

40708 (KFK—4100, pp 4100/29-4100/36) **Investigation of the critical mass flux through small leaks.** John, H.; Eisele, G.; Reimann, J.; Wanner, E.; Weinbrecht, R.; Barth, S.; Pawlak, L. Sep 1987. (In German). NTIS (US Sales Only), PC A16/MF A01. Order Number DE88754024/JAW.

In Nuclear Safety Project. Annual report 1986.

The measured critical mass flux was compared with several models (Pana, Abdollahian, I, II). It was found that by using the modified Pana Model the best agreement between measurement and calculation could be obtained. The standard deviation of the predictions from the measurements for 458 experimental points was below 20%.

40709 (KFK—4100, pp 4100/50-4100/53) **Vectorization and optimization of COMMIX-2.** Borgwaldt, H. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Neutronenphysik und Reaktortechnik). Sep 1987. NTIS (US Sales Only), PC A16/MF A01. Order Number DE88754024/JAW.

In Nuclear Safety Project. Annual report 1986.

Work has been started to adapt COMMIX-2 to modern vector computers. Previous experience with a similar code, BODY-FIT-1FE, has shown that with vector computers performance gains of one order of magnitude may be achieved by suitable optimization. Starting point for this vectorization effort was a version of COMMIX-2, which had already undergone a large amount of cleaning-up and restructuring. As the code is expected to run on different computers, at least on IBM-compatible equipment and on the CYBER-205, the first step was to fully enforce the FORTRAN 77 standard.

40710 (KFK—4100, pp 4100/79-4100/93) **Investigation of transient interfacial exchange processes in two-phase flow (NOVA program).** Class, G.; Eberle, F.; Gering, G.; Meyder, R.; Philipp, P.; Lang, K.H.; Sengpiel, W. Sep 1987. (In German). NTIS (US Sales Only), PC A16/MF A01. Order Number DE88754024/JAW.

In Nuclear Safety Project. Annual report 1986.

In all experiments a void drift towards the wall was found leading to characteristic peaks of relative gas content at the channel wall. Radial shapes of axial turbulent liquid fluctuations measured at z=70 D reveal an increase of the turbulent intensity towards the wall and a minimum in the center of the tube. The profiles of turbulent axial fluctuations are flatter in comparison to single-phase flows. It has been found that at least in the lower range of liquid superficial velocities up to 1 m/s, the axial turbulent intensities are generally raised by the existence of the bubbles.

40711 (KFK—4369) **Measuring probe for measurement of local velocities.** Casal, V.; Arnold, G.; Kirchner, R.; Kussmaul, H.; Miller, H.; Hame, W. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Reaktorbauelemente; Ingenieurbuero W. Hame, Karlsruhe (Germany, F.R.)). (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Reaktorbauelemente; Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Reaktorbauelemente). Mar 1988. 37p. (In German). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88754183/JAW.

The report describes a method for measurement of local velocities. It bases on the detection of the propagation of a temperature pulse induced into the fluid. The method can also be applied in flowing liquid metals with superimposed magnetic field; in this case common measuring principles fail application. The measuring system discussed consists of, a measuring head, a heating system, amplifiers and a PC. The latter performs process operation, data sampling, and evaluation of velocity. The measuring head itself includes a miniaturized heater (as a pulse marker) heated by the heating system in a short pulse, and a number of thermocouples (sensors) for detection of signals. The design, construction, and examination of a developed measuring device is described.

40712 (N—88-21160) **Utilization of parallel processing in solving the inviscid form of the average-passage equation system for multistage turbomachinery.** Mulac, R.A.; Celestina, M.L.; Adamczyk, J.J.; Misegades, K.P.; Dawson, J.M. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). 1987. 13p. (NASA-TM—89845; E—3508; NAS—1.15:89845; CONF-8706104—). NTIS, PC A03/MF A01.

From 8. American Institute of Aeronautics and Astronautics computational fluid dynamics conference; Honolulu, HI, USA (9 Jun 1987).

A procedure is outlined which utilizes parallel processing to solve the inviscid form of the average-passage equation system for multistage turbomachinery along with a description of its implementation in a FORTRAN computer code, MSTAGE. A scheme to reduce the central memory requirements of the program is also detailed. Both the multitasking and I/O routines referred to are specific to the Cray X-MP line of computers and its associated SSD (Solid-State Disk). Results are presented for a simulation of a two-stage rocket engine fuel pump turbine.

40713 (NUCLEBRAS-CDTN—561) **Reactor safety activities at the Centro de Desenvolvimento da Tecnologia Nuclear (CDTN)-Nuclebras.** Pinheiro, R.B. (Centro de Desenvolvimento da Tecnologia Nuclear, Belo Horizonte (Brazil)). Aug 1986. 57p. (In Portuguese). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88701706/JAW.

This report presents the major activities developed at NUCLEBRAS in the area of Reactor Safety. The Thermohydraulics and Reactor Safety program consists of activities in the analytical and experimental area. The more recent activities under way in the analytical area are presented together with some results. They are mainly related to the development and assessment of advanced computer codes to be used in the analysis of the behavior of the plant during operational transients and postulated accidents and in thermohydraulic core design. In the experimental area, the main accomplishments and activities under way are reported they refer to steady state CHF tests in a 9-rod bundle and rewetting experiments in a tubular test section. In particular, the status of the design development of a new facility for Separate Effects LOCA tests (DTL-ES) is described. Concerning the Components Testing program, the basic characteristics of a valve test facility (CTC) are described and the present status of its construction is reported. Reference is also made to existing installations and a summary of tests already performed for Angra-2 components qualification is presented.

40714 (NUREG/CP—0091-Vol.4, pp 127-141) **Non-equilibrium vaporization in the post-CHF heat transfer regime.** Unal, C.; Tuzla, K.; Neti, S.; Chen, J.C. (Lehigh Univ., Bethlehem, PA (USA)). Feb 1988. NTIS, PC A99/MF A01 - GPO. Order Number TI88007181/JAW. (CONF-8710111—Vol.4).

From 15. water reactor safety information meeting; Gaithersburg, MD, USA (26 Oct 1987).

An experimental study of convective film boiling (post-CHF) was carried out for low pressure steam and water flow in a nine-rod bundle with heated shroud. Measurements of wall heat flux, wall superheat, and vapor superheat were obtained as a function of axial distance from the CHF quench front for a range of flow rates and flow qualities. Three series of tests were carried out: (1) fixed quench front with the CHF dryout point stabilized at test section inlet, (b) reflood with advancing quench front propagating upward through the test section, (c) dryout with the quench front retreating upstream downwards through the test section. A total of 467 data points were generated from 144 experimental runs which were executed in the following range of conditions: Coolant Mass Flux - 0.1 to 26 kg/m^{2}s; Inlet Quality - 40°C subcooled to 0.40; Pressure - 105 to 120 kPa; and Heat Flux - 5 to 43 kW/m^2.

40715 **Boundary integral analysis of flow and deformation of long bubbles in capillaries.** Martinez, M.J.; Udell, K.S. (Dept. of Mechanical Engineering, Univ. of California, Berkeley, Berkeley, CA (US)). pp 5-12 of Multiphase transport in porous media. Eaton, R.; Udell, K.S.; Kaviany, M. New York, NY; American Society of Mechanical Engineers (1988). (CONF-871234—).

From ASME winter meeting; Boston, MA, USA (13 Dec 1987).

A boundary integral analysis of the creeping motion of a long inviscid bubble in a liquid-filled tube is presented. The effects of interfacial surface tension are included in the stress balance across the liquid-bubble interface. Velocities, stresses and the bubble profile are obtained as a function of the capillary number. Computed values of the thickness of the liquid film between the bubble and tube wall are in excellent agreement with published experimental measurements. The results are of interest in exposing the role of surface tension in multiphase flow in capillary tubes and porous materials.

40716 **Multiphase transport in porous media.** Eaton, R.; Udell, K.S.; Kaviany, M. New York, NY; American Society of Mechanical Engineers (1988). 85p. (CONF-871234—). American Society of Mechanical Engineers, 345 East 47 St., New York, NY 10017.

From ASME winter meeting; Boston, MA, USA (13 Dec 1987).

This book contains papers on multiphase transport in porous media. Topics include the following: boiling and two phase flow in heat pipes; probabilistic analysis of contaminant transport in porous materials, and the effect of gravity on steam propagation in porous materials.

40717 **Two-phase computer codes for zero-gravity applications.** Krotiuk, W.J. pp 1421-1432 of Aerospace century XXI: Space sciences, applications, and commercial developments; Proceedings of the Thirty-third Annual AAS International Conference, Boulder, CO, Oct. 26-29, 1986. Morgenthaler, G.W.; Koster, J.N. San Diego, CA; Univelt, Inc. (1987). (CONF-8610219—).

From 33. annual meeting of the American Astronautical Society - aerospace: century 21; Boulder, CO, USA (27 Oct 1986).

This paper discusses the problems existing in the development of computer codes which can analyze the thermal-hydraulic behavior of two-phase fluids especially in low gravity nuclear reactors. The important phenomenon affecting fluid flow and heat transfer in reduced gravity is discussed. The applicability of using existing computer codes for space applications is assessed. Recommendations regarding the use of existing earth based fluid flow and heat transfer correlations are made and deficiencies in these correlations are identified.

40718 **The response of materials to dynamic loading.** Asay, J.R.; Kerley, G.I. (Sandia National Labs., Albuquerque, NM (US)). pp 69-100 of Hypervelocity impact. Anderson, C.E. Elmsford, NY; Pergamon Books Inc. (1987). (CONF-861091—).

From Hypervelocity impact symposium; San Antonio, TX, USA (21 Oct 1986).

The response of materials to hypervelocity impact spans a wide region of material behavior, ranging from high impact pressures and temperatures, where thermodynamic effects prevail, to low pressures where mechanical properties are important. This paper discusses thermomechanical and physical processes important to hypervelocity impact events, presents a perspective of theoretical foundations, and provide an overview of current equation-of-state and constitutive modeling capabilities.

4205 Materials Testing

REFER ALSO TO CITATION(S) 39607, 40270, 40307, 40352, 40588, 40589, 40626

40719 **(AD-A—190757/5/XAB) Computational model for armor penetration. Annual report No. 3, October 1980-April 1983.** Erlich, D.C.; Seaman, L.; Cooper, T.; Caligiuri, R.D.; Curran, D.R. (SRI International, Menlo Park, CA (USA)). Oct 1987. 116p. NTIS, PC A06/MF A01.

This is the first volume of a two-volume series comprising the third annual report for the program Computational Model for Armor Penetration. The objective of the program was to develop a phenomenologically sound material-disintegration model for computationally simulating armor penetration by projectile impact. The model would provide the capability to predict the ballistic limit and downrange fragment size and velocity distributions and would eventually be used by the DoD for armor and penetrator design. The materials studied in the program were 4340 steel and depleted uranium alloy, (DU) for the penetrators, and rolled homogeneous armor (RHA) for the target. This Volume reports on the experimental and analytical work performed during the third year to conclude the development of a computational model, SHEAR3, that describes the dominant material failure and fragmentation process (adiabatic shear banding) responsible for long-rod penetrator erosion and thick armor plate plugging and fragmentation. Volume 1 also describes application of SHEAR3 with the Lagrangian wave propagation code C-HEMP to computationally simulate penetration of armor plate by normally impacting long rods both near the ballistic limit and at higher velocities sufficient to produce significant back-of-the-armor fragmentation.

40720 **(AD-A—190804/5/XAB) High-temperature solid lubrication by catalytically generated carbon.** Lauer, J.L.; Bunting, B.G. (Rensselaer Polytechnic Inst., Troy, NY (USA). Dept. of Mechanical Engineering). 1987. 13p. NTIS, PC A03/MF A01.

The wear process in bearings generates a clean active surface. Carbon is known to form readily on catalytic surfaces through the reduction of carbon oxides or hydrocarbon. Carbon, through the adsorption of hydrocarbons, water vapor, or oxygen, becomes an effective lubricant. If these three phenomena can be made to work together, a new concept of high-temperature lubrication would be available. This paper presents laboratory investigations towards the development of this concept. Carbon was successfully produced through catalytic reduction of ethylene on a variety of metallic and ceramic surfaces containing nickel. This carbon has been shown to reduce friction at a sliding interface at elevated temperatures.

40721 **(CEA-CONF—9283) Recent developments in ultrasonic probes working up to 180 deg C for the inspection of the Superphenix fast breeder reactor.** Gondard, C. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Dept. de Technologie). 1987. 14p. (CONF-8706317—). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88753908/JAW.

From Ultrasonic NDT at elevated temperatures; Northampton, UK (18 Jun 1987).

The main and safety vessels of SUPERPHENIX were designed to allow In-Service-Inspections. The remote controlled device MIR was developed for this purpose. The ultrasonic examination has required the development of all new focused transducers fitted with severe operating conditions prevailing in the intervessels interval: nitrogen gas at 180/sup 0/C. We give a list of problems to be resolved and technological solutions which were found. Measurements of acoustical properties on actual probes are compared with theoretical values. We produce some examples obtained in actual conditions which show the detection of reference reflectors located in welds at various depth, with various disalignements against focus beam. Inspite of the severe environment and the perturbations caused by the austenitic welds, the I.S.I of SPX1 using high temperatures transducers is possible with a good spatial resolution and signal to noise ratio.

40722 (FhG-IzfP—850107-TW) Determination of the equivalent flaw size by means of spatial signal averaging for the ultrasonic inspection of heavily scattering materials. Kapitza, H. (Fraunhofer-Gesellschaft zur Foerderung der Angewandten Forschung e.V., Saarbruecken (Germany, F.R.). Inst. fuer Zerstoerungsfreie Pruefverfahren). 28 May 1985. 93p. (In German). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88753788/JAW.

Taking as a basis the known amplitude distribution of ultrasonic scattering (RAYLEIGH distribution) and the RICE distribution derived therefrom, an algorithm has been developed for the determination of equivalent flaw size by spatial signal averaging (i.e. variation of probe positions). The algorithm and the software for application are explained. The algorithm takes into account the effects of the local amplitude curve. The method for determining the accuracy of the evaluation algorythm is described. (orig./HP)

40723 (FhG-IzfP—860538-TW) Improvement of the defect detection capability of ultrasonic inspection of coarse-grained austenitic materials by means of a combination of signal enhancement methods. Final report. Kapitza, H. (Fraunhofer-Gesellschaft zur Foerderung der Angewandten Forschung e.V., Saarbruecken (Germany, F.R.). Inst. fuer Zerstoerungsfreie Pruefverfahren). 27 Sep 1986. 73p. (In German). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88753789/JAW.

The decorrelation of ultrasonic, scattered signals by spatial or frequency variation is determined, together with the number of scattered signals with given flattening of the background. A prototype device is available that allows an examination of the geometry of electromagnetic ultrasonic transducers (EMUS transducer) for the generation of shear horizontal waves. Ultrasonic propagation in textured materials (such as austenitic seam welds) is described analytically and numerically. (DG)

40724 (INIS-mf—11686) Application of a pulse eddy current process for the non-destructive testing of austenitic pipes damaged by corrosion. Wittig, G.; Thomas, H.M.; Maser, D.; Hennig, P.; Weigelt, G. (Bundesanstalt fuer Materialpruefung, Berlin (Germany, F.R.)). Dec 1986. 97p. (In German). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88753798/JAW.

Attempts are made not only to show damage, which leads to remaining wall thicknesses below 80%, with certainty, but also to obtain information on the remaining wall thickness from the indications. The aim of the project is to transfer laboratory results and other available experience to appropriate tasks from industrial practice. The previously developed test techniques are to be tried, adapted to occurring situations and, if necessary, improved. By taking part in a ring experiment, there is a comparison of the performance of test methods, which were developed by other research institutions. (orig./IHOE)

40725 (JAERI-M—88-013) SATCAP: a program for thermal-hydraulic design of saturated temperature capsule. Harayama, Yasuo; Niimi, Motoji; Someya, Hiroyuki; Kobayashi, Toshiki. (Japan Atomic Energy Research Inst., Tokyo). Feb 1988. 55p. (In Japanese). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88753628/JAW.

For material irradiation tests at JMTR, user's technical requirements are gradually becoming more rigid, permitting only a small temperature deviation from the desired during irradiation of test materials. As specimen temperature control equipment, several conception were proposed and some of them were translated into actual machines with the capsule having electrical seath heaters in it. This system is highly reliable unless the integrity of the heaters is threatened. However, in a test with the object of achieving a high exposure of specimen to neutrons, the break of a heater or deterioration of a heater caused by irradiation lowers the reliability of the system. To cope with this drawback, as a part of the irradiation technique improvement program, "Satulated Temperature Capsule" has been developing. This type capsule, in which the water suplied is boiled, bases on the conception of keeping the coolant at the saturated temperature facilitates the temperature control. Though there are various types of capsules employed at JMTR, the experience of the capsule into which the coolant is injected lacks. In designing, thermal performances have to fully understood. Therefore, a program was compiled to evaluate the thermal behavior in the capsule. The present report describes the calculation procedure and guides of input and output for the program.

40726 (JAERI-M—88-041) Proposed standard method for tensile testing of structural alloys at liquid helium temperature. Nakajima, Hideo. (Japan Atomic Energy Research Inst., Tokyo). Mar 1988. 20p. (In Japanese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88754121/JAW.

There are no standard methods of a cryogenic material testing at present. It is absolutely required to standardize standard test method at a cryogenic temperature in order to establish a data base or cryogenic structural materials for large superconducting magnet. For this purpose evaluations of cryogenic structural materials are conducted by using the test method based on a room temperature standard. The standardization of a cryogenic tensile test method and a cryogenic fracture toughness test method was performed under the US-Japan fusion collaboration. A US scientist stayed in JAERI both for experimental work and for standardization discussion. An agreed basis by both side was established. This JAERI-M report is the draft of cryogenic tensile test standard in Japanese which is expected to be used for the JIS (Japanese Industrial Standard) application discussion. A similar draft in English was drafted by a US scientist and was already proposed to ASTM (American Society for Testing and Materials) committee.

40727 (N—88-21468, pp vp) Torque and wear behavior of selected thin film MOS_2 lubricated gimbal bearings. Bohner, J.J.; Conley, P.L. May 1988. NTIS, PC A18/MF A01. (NASA-CP—2506; L—16433; NAS—1.55:2506; CONF-880545—).

From 22. aerospace mechanisms symposium; Hampton, VA, USA (4 May 1988).

During the thermal vacuum test phase of the GOES 7 spacecraft, the primary scan mirror system exhibited unacceptably high drive friction. The observed friction was found to correlate with small misalignments in the mirror structure and unavoidable loads induced by the vehicle spin. An intensive effort to understand and document the performance of the scan mirror bearing system under these loads is described. This effort involved calculation of the bearing loads and expected friction torque, comparison of the computed values to test data, and verification of the lubrication system performance and limitations under external loads. The study culminated in a successful system launch in February of 1987. The system has operated as predicted since that time.

40728 (N—88-21468, pp vp) Titanium carbide coatings for aerospace ball bearings. Boving, H.J.; Haenni, W.; Hintermann, H.E. May 1988. NTIS, PC A18/MF A01. (NASA-CP—2506; L—16433; NAS—1.55:2506; CONF-880545—).

From 22. aerospace mechanisms symposium; Hampton, VA, USA (4 May 1988).

In conventional ball bearings, steel to steel contacts between the balls and the raceways are at the origin of microwelds which lead to material transfer, surface roughening, lubricant breakdown, and finally to a loss in the bearing performances. To minimize the microwelding tendencies of the contacting partners it is necessary to modify their surface materials; the solid to solid collisions themselves are difficult to avoid. The use of titanium carbide coated steel balls can bring spectacular improvements in the performances and lifetimes of both oil-grease lubricated and oil-grease free bearings in a series of severe applications.

40729 (Y/Sub—85-27448/1) Simulated acoustic emission in a composite test assembly: Final report. Hamstad, M.A. (Denver Univ., CO (USA). Dept. of Engineering). 15 Aug 1985. Contract AC05-84OS21400. 46p. NTIS, PC A03;3. Order Number DE88010795/JAW.

A study was made of the effects of frequency bandpass, internal fluid, and internal fluid pressure on simulated acoustic emission (AE) in a composite test assembly. The results of this study

indicate requirements for AE source location and calibration in such a test assembly. 3 refs., 17 figs., 10 tabs.

40730 Robotized x-ray inspection station. Laperle, C. *Cadmat News;* 35-36(1 Apr 1984).

GE's Neutron Devices Department (GEND) is currently in Phase 1 of a two-phase program aimed at using a 6-axes jointed arm robot in a real-time x-ray inspection application. Phase 1 of the program has a two-fold objective. One objective was to automate the existing x-ray inspection process; the second was to reach conclusions concerning the effects of long-term radiation exposure on the robot optical encoders. Phase 1 was implemented in production in July of 1983. Phase II is scheduled for development early 1984.

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REFER ALSO TO CITATION(S) 40377, 40421, 40453, 40454, 40455, 40456, 40457, 40459, 40476, 40477, 40615, 40649, 40814, 40815, 41082, 41084, 41085, 41333, 42123, 42125, 42501, 42515, 42529

40731 (AD-A—190239/4/XAB) Joint Services electronics program. Annual report, 1 May 1986-30 April 1987. Harris, J.S. (Stanford Univ., CA (USA). Dept. of Electrical Engineering). 30 Apr 1987. 63p. NTIS, PC A04/MF A01.

Contents include: quantum-well and reduced dimensional semiconductor systems, ultra-submicron devices, and Ga/As silicon integrated circuits; chemical and electronic structure of refractory metal gaas interfaces; study of crystal properties using channeling radiation; complementary MOS device and material physics at 77°K, real-time statistical signal processing; and coding for spectrally constrained channels.

40732 (AD-A—191304/5/XAB) Two-mode radiation from light-emitting tunnel junctions. Pierce, R.M.; Rutledge, J.E.; Ushioda, S. (California Univ., Irvine (USA). Dept. of Physics). 15 Jul 1987. 51p. NTIS, PC A04/MF A01.

Pub. in Physical Review B, Vol. 36, No. 3, 1803-1806(15 Jul 1987).

A prism coupler was employed to cause two independent surface-plasmon polariton modes of a metal-insulator-metal tunnel junction to radiate. The radiative coupling of the modes was characterized by attenuated-total-reflection spectrometry and the angular dependence of the emitted light was m. Each of the radiative modes is supported by one of the metal surfaces farthest from the tunneling barrier. A model calculation suggests that the modes are excited at the surfaces that support them.

40733 (LA—11035-MS) Characterization of new FPS [Focus Projection and Scale] vidicons for scientific imaging applications. Yates, G.J.; Jaramillo, S.A.; Holmes, V.H.; Black, J.P. (Los Alamos National Lab., NM (USA)). Jun 1988. Contract W-7405-ENG-36. 36p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88011213/JAW.

Several new photoconductors now commercially available as targets in Type 7803 FPS (Focus Projection and Scan) electrostatically focussed vidicons have been characterized for use as radiometric sensors in transient illumination and single frame applications. These include Saticon (Se {plus} Te {plus} As), Newvicon (ZnSe), Pasecon (CdSe), and Plumbicon (PbO). Samples from several domestic and foreign manufacturers have been evaluated for photoconductive response time and responsivity at selected narrow wavelength bands, including 410 nm, 560 nm, and 822 nm. These data are compared with performance data from older target materials including antimony trisulfide (Sb_2S_3) and silicon. Dynamic range and resolution trade-offs as functions of read-beam aperture diameter and raster size are also presented. The point spread functions for standard 1-mil vidicons and for increased apertures of 1.5, 2.0, 3.0, and 4.0-mil are also discussed. 8 refs., 42 figs.

40734 (PNL-SA—15738) An infrared simulator for testing electro-optical systems against smoke and obscurants. Batishko, C.R.; Craig, R.A.; Stahl, K.A.; Salomon, L.L.; Bodrero, D. (Pacific Northwest Lab., Richland, WA (USA); Dugway Proving Ground, UT (USA)). 1988. Contract AC06-76RL01830. 10p. (CONF-880489—1). NTIS, PC A02/MF A01;1; GPO Dep. Order Number DE88008202/JAW.

From Infrared science simulation: systems, requirements, calibration, devices, and modeling; Orlando, FL, USA (5 Apr 1988).

This paper describes the concept and current status in the development of an infrared simulator for testing electro-optical (EO) sensor systems against smoke/obscurants. The objective of the research is to implement realistic indoor smoke/obscurant testing of a variety of military electro-optical sensor systems under highly repeatable, computer-controllable conditions. The concept is to replay appropriate, previously recorded imagery from free-air smoke/obscurant field tests, utilizing an infrared scene genrator. A reduced set of requirements was developed by limiting the application to a HgCdTe-based sensor system, the tank thermal slight, which represents a class of FLIRs that might be tested using the simulator. The simulator's requirements in terms of the role of scattering, target spectral characteristics, dynamic range, time constant, and spatial resolution are discussed. A group of technical approaches to infrared scene generation and their relative attributes are briegly reviewed, and the technical approach selected for continued development is described. The status of the research and performance of the current proof-of-concept image generator are summarized. 4 refs., 7 figs.

40735 (SAND—87-0952) An explosive acoustic telemetry system for seabed penetrators. Hauser, G.C.; Hickerson, J. (Sandia National Labs., Albuquerque, NM (USA)). Apr 1988. Contract AC04-76DP00789. 49p. NTIS, PC A04;3. Order Number DE88011764/JAW.

This report discusses the design and past applications of an explosive acoustic telemetry system (EATS) for gathering and transmitting data from seabed penetrators. The system was first fielded in 1982 and has since been used to measure penetrator performance on three other occasions. Descriptions are given of the mechanical hardware, system electronics, and software.

40736 (SAND—87-3095-C2) Semiconductor bridge (SCB) igniter studies: II, Comparison of SCB and hot-wire direct propulsion thrusters. Bickes, R.W. Jr.; Schlobohm, S.L.; Bonas, A.G.; Headley, P.S. (Sandia National Labs., Albuquerque, NM (USA); Crane Unidynamics Phoenix, AZ (USA)). 1988. Contract AC04-76DP00789. 7p. (CONF-880750—2). NTIS, PC A02/MF A01;1; GPO Dep. Order Number DE88008803/JAW.

From 13. international pyrotechnics seminar; Grand Junction, CO, USA (11 Jul 1988).

In this paper we present a comparison of the Crane Unidynamics/Phoenix hot-wire thrusters with the same thrusters made with Type 3-2 SCB igniters. (See paper I for details about the SCB igniter.) For both types of thrusters we obtained pressure versus time profiles and determined the function times, the peak pressures and the thruster impulses. The function times for the SCB components were shorter than the hot-wire device times, 350μs versus 700 μs, respectively. However, despite the shorter function times, the firing energies for the SCB devices were approximately 4 mJ, as opposed to 36 mJ required for the hot-wire thrusters. In addition, the SCB bridges were completely consumed in less than 10 μs compared to the hot-wire burst times of 665 μs; therefore, the repetition interval for the SCB thrusters could be as short as 10 μs allowing several SCB devices to be fired during the same time interval required for one hot-wire thruster. We believe that the lower energy, faster functioning and faster repetition rate of SCB thrusters offer advantages for future guidance control systems.

40737 **(SAND—88-0175) A Null DTE Fifo buffer for multi-segment communications circuits.** George, M. (Sandia National Labs., Albuquerque, NM (USA)). Jun 1988. Contract AC04-76DP00789. 30p. NTIS, PC A03;3. Order Number DE88012411/JAW.

The Null DTE Fifo was designed to buffer data between two modem pair links in a multi-segment communications circuit. Data buffering assures that valid data are being clocked into the local modems of both links. Without this active data buffer, constant phase errors between the two local modems' clocks may cause data errors, and thus, unacceptable circuit throughput. During the course of communication circuit design, a set of communications symbols was developed to aid in the process. These symbols not only simplify circuit design, but provide a standard set to minimize interpretation problems among the circuit designers. The symbol set can be used to represent various devices in a circuit, such as modems, computers, terminals, encryption devices, converters, etc. In addition, the propagation of clock, data, and control signals through the circuit can be represented. Clocking modes on synchronous components (modems, multiplexers, etc.) and signal line crossovers can be determined from the drawings during the design process. This set of symbols, along with the rules of their use, comprise a very efficient design tool.

40738 **(SAND—88-0291C) Non-line-of-sight (NLOS), secure, low-probability of intercept (LPI), antijam (AJ), high frequency (HF), real time video communication system.** Lupinetti, F. (Sandia National Labs., Albuquerque, NM (USA)). 1988. Contract AC04-76DP00789. 11p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88008328/JAW.

This paper outlines a video communication system capable of non-line-of-sight (NLOS), secure, low-probability of intercept (LPI), antijam, real time transmission and reception of video information in a tactical enviroment. An introduction to a class of ternary PN sequences is presented to familiarize the reader with yet another avenue for spreading and despreading baseband information. The use of the high frequency (HF) band (1.5 to 30 MHz) for real time video transmission is suggested to allow NLOS communication. The spreading of the baseband information by means of multiple nontrivially different ternary pseudonoise (PN) sequence is used in order to assure encryption of the signal, enhanced security, a good degree of LPI, and good antijam features. 18 refs., 3 figs., 1 tab.

40739 **(SAND—88-0333C) High current photoconductive semiconductor switches.** Loubriel, G. M.; O'Malley, M. W.; Zutavern, F. J.; McKenzie, B. B.; Conley, W. R.; Hjalmarson, H. P. (Sandia National Labs., Albuquerque, NM (USA)). 1988. Contract AC04-76DP00789. 20p. (CONF-880699—2). NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88011541/JAW.

From 18. power modulator symposium; Hilton Head, SC, USA (20 Jun 1988).

Photoconductive Semiconductor Switches (PCSS) are a completely different type of switch than those currently used in pulsed power applications. The most important attributes of PCSS are jitter-free triggering, low inductance, fast rise time, fast recovery (opening time), and high repetition rate. The most important limitation of the PCSS is the higher laser power required to activate them and the low-electric fields that they switch. These two issues are related because, for a given voltage that needs to be switched, a low field implies a large "gap" and, hence, a very large laser energy. This is especially troublesome since the laser energy required to reach a given switch resistance is proportional to the square of the gap spacing. In this paper we descibe major advances in PCSS. The first section describes how we are able to switch higher fields. Si can be used to switch fields of up to 82 kV/cm (a voltage of 123 kV across 1.5 cm), more than a factor of two higher than the 36 kV/cm that we reported a year ago. The development of PCSS for use in pulsed power application requires the ability to switch both high voltages and large currents. Having made significant progress in voltage standoff and switched fields, we are now concentrating on the current density issue. The second section describes the devlopment of two-impedance systems to test the maximum currents that the samples can switch. Presently the best we can switch corresponds to 4.0 kA (distributed over 2.1 cm) or 3.2 kA/cm (a current of 800 A distributed over a width of 0.25 cm) for GaAs in our sub-{OMEGA} impedance test system. The third section focuses on the lock-on phenomenon first reported by our laboratory a year ago. 12 refs., 6 figs., 2 tabs.

40740 **(SAND—88-0389) A fiber optic synchronous detector using sample-and-hold circuits.** Pfeifer, K.B. (Sandia National Labs., Albuquerque, NM (USA)). May 1988. Contract AC04-76DP00789. 22p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88010973/JAW.

A design for a synchronous driver and detector for single-ended optical fiber sensing applications is presented. The circuit is discussed in detail. A derivation of the equations relating the input to the output for the sampler is given. A brief discussion of the operation of the prototype is given. Finally, the paper concludes with an example of an application of the device. 8 refs., 7 figs.

40741 **(SAND—88-0982) A method for handling slanted conducting surfaces in EM PIC codes.** Pointon, T.D. (Sandia National Labs., Albuquerque, NM (USA)). Jun 1988. Contract AC04-76DP00789. 59p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE88013142/JAW.

A new version of MAGIC, a 2-1/2D relativistic electromagnetic particle simulation code, has been developed to handle slanted conducting surfaces. Modifications to standard algorithms for the electromagnetic field advance, charge and current densities, particle destruction, and field averaging are discussed. In addition, a new model for field emission from conducting boundary surfaces is described. Particles can be emitted from conformal or slanted surfaces, and also from certain types of corners. Results of the new code on several problems are presented. 10 refs., 15 figs.

40742 **(SAND—88-7007C) A calculational procedure for gamma-ray box IEMP.** Leadon, R.; Walters, D.; Seidler, W.; Beezhold, W.; Lorence, L. (JAYCOR, Del Mar, CA (USA); Sandia National Labs., Albuquerque, NM (USA)). 1988. Contract AC04-76DP00789. 28p. (CONF-880237—2). NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88007586/JAW.

From Hardened electronics and radiation technology conference; Santa Ana, CA, USA (1 Feb 1988).

An approximate procedure is presented for calculating the gamma-ray box IEMP short-circuit-current response of lands on PC boards. Calculated results are compared to experimental data obtained previously at Aurora on phenomenology PC boards with different land widths and board-land configurations. These comparisons illustrate the importance of adequately modeling in gamma-ray box IEMP calculations the amount of shielding between the gamma ray source and the test cassette. 23 refs., 13 figs.

40743 **(UCID—21405) A description of the circuit management algorithm.** Palasek, R. (Lawrence Livermore National Lab., CA (USA)). 20 Jan 1988. Contract W-7405-ENG-48. 26p. (L—005343). NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88011355/JAW.

This paper discusses, explains, and refines the algorithm for trunk management introduced previously. The major structural change is the promotion of the step that checks for locked trunks. That step is brought out of the iterative loop. The second part of the paper explains how to find the set of all loop-free paths between two switches, outlines a proof that the technique is correct, and discusses its computational complexity. 5 refs., 12 figs.

40744 **On the statistical properties of a cyclic diffusion process arising in the modeling of thermostat-controlled electric power system loads.** Malhame, R.; Chong, C.Y. (Ecole Polytechnique de Montreal, Departement de Genie Electrique, Montreal, Quebec (CA)). *SIAM Journal on Applied Mathemadics;* **48**: No. 2, 465-480(Apr 1988).

A cyclic diffusion process - a member of the class of hybrid-state Markov processes - has been used to construct aggregate load models for a portion of power system loads controlled by thermostat (heating or cooling loads), following an approach inspired from the methods of statistical mechanics. The statistical properties of

the process are analysed using renewal theory and the Fokker-Planck equation.

40745 **A flexible 128 channel silicon strip detector instrumentation integrated circuit with sparse data readout.** Kleinfelder, S.A.; Carithers, W.C. Jr.; Ely, R.P. Jr.; Haber, C.; Kirsten, F.; Spieler, H.G. (Lawrence Berkeley Lab., Berkeley, CA (US)). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* **35**: No. 1, 171-175(Feb 1988). (CONF-871006—).

From 34. nuclear science symposium and 19. nuclear power systems symposium; San Francisco, CA, USA (21 Oct 1987).

A new full custom CMOS integrated circuit for silicon strip detector systems has been design, fabricated and tested. The I.C. contains 128 parallel data acquisition channels and considerable peripheral circuitry. Each channel consists of a low noise, low power charge sensitive amplifier, a multi-stage auto-balanced comparator, an analog multiplexer, nearest neighbor logic, priority search logic and a share of a position encoding read-only memory. The analog system can subtract both detector pedestal and leakage current on a channel by channel basis. A key feature of this design is the inclusion of on-chip sparse read-out circuitry, which allows efficient management of low occupancy events. Designed for use at the Collider Detector Facility (CDF) at Fermilab, it is suitable for large scale silicon detector systems where a large, dense array of fast, low power electronics is required.

40746 **Radiation damage studies of a custom-designed VLSI readout chip.** Dauncey, P.; Barnett, B.A.; Drewer, D.; Matthews, J.A.J.; Breakstone, A.; Parker, S.; Adolphsen, C.; Gratta, G.; Litke, A.; Schwarz, A.S. (Johns Hopkins Univ., Baltimore, MD (US)). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* **35**: No. 1, 166-170(Feb 1988). (CONF-871006—).

From 34. nuclear science symposium and 19. nuclear power systems symposium; San Francisco, CA, USA (21 Oct 1987).

Two structurally similar versions of an NMOS custom VLSI circuit, manufactured at different foundries, have been irradiated with a /sup 60/Co source up to doses of 100 krad. Large differences in their behaviours after irradiation have been seen which are thought to be due to the fabrication processes. These differences are observed in test structure measurements and over-all chip performance. An increase in circuit noise causes one version of the chip to be unusable after radiation doses of 20 krad.

40747 **Automatic testing of high resolution time digitizers.** Kolbe, W.F.; Turko, B. (Lawrence Berkeley Lab., Univ. of California, Berkeley, CA (US)). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* **35**: No. 1, 187-190(Feb 1988). (CONF-871006—).

From 34. nuclear science symposium and 19. nuclear power systems symposium; San Francisco, CA, USA (21 Oct 1987).

An automated system for the testing and performance evaluation of high-resolution long-range time digitizers is described. The test system employs an IBM PC/XT or PC/AT personal computer together with appropriate hardware interfacing modules to control the digitizer under test. Precise timing intervals for testing are generated by a pulse calibration module driven by a programmable low phase noise frequency synthesizer. The time intervals measured by the digitizer are then compared under computer control with the actual intervals produced by the synthesizer for a sufficient number of cases to establish the digitizer performance. The hardware and software components used are discussed.

40748 **Development of a switched capacitor based multichannel transient waveform recording integrated circuit.** Kleinfelder, S.A. (Lawrence Berkeley Lab., Berkeley, CA (US)). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* **35**: No. 1, 151-154(Feb 1988). (CONF-871006—).

From 34. nuclear science symposium and 19. nuclear power systems symposium; San Francisco, CA, USA (21 Oct 1987).

The paper describes a new full custom integrated circuit addressing the problem of transient analog signal recording. The chip includes 2048 sample and hold cells, fast clock generation logic and readout amplifiers. The 2048 sample and hold circuits are divided into 16 channels of 128 samples per channel. One read amplifier is used per channel. Clock signals are generated via on chip redundant interleaved shift registers. The circuit is designed in an inexpensive and widely available three micron, single metal, double polysilicon CMOS process. The process allows easy integration of high density digital and analog circuitry with the possibility of very low power operation. Prototypes have been fabricated and proven to be operational.

40749 **An integrated engineering simulation environment.** Alvarado, F.L.; Lasseter, R.H.; Liu, Y. (Electrical and Computer Engineering, The Univ. of Wisconsin-Madison, WI (US)). *IEEE Transactions on Power Systems;* **3**: No. 1, 245-253(Feb 1988).

This paper presents an implementation of a new concept, the Integrated Engineering Simulation Environment (IESE). At the core of the IESE is an object-oriented database system which uses semantic data models and graphics-oriented manipulations. An on-line rule-based expert system is incorporated to enforce constraints on connections. Examples of application of the IESE to Electromagnetic Transient Simulations are presented. The main result of the paper is to establish the generality of this new approach to engineering software development, and to show that extremely diverse applications (including graphics interfaces) can be accommodated by simple modifications to database schemata, without reprogramming.

40750 **An SEU tolerant memory cell derived from fundamental studies of SEU mechanisms in SRAM.** Weaver, H.T.; Axness, C.L.; McBrayer, J.D.; Browning, J.S.; Fu, J.S.; Ochoa, A. Jr.; Koga, R. (Sandia National Labs., Div. 1141, Albuquerque, NM (US)). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* **NS-34**: No. 6, 1281-1286(Dec 1987). (CONF-8707112—).

From Annual conference on nuclear and space radiation effects; Snowmass Village, CO, USA (28 Jul 1987).

A new single event upset (SEU) hardening concept, an LRAM cell, is demonstrated theoretically and experimentally. Decoupling resistors in the LRAM are used only to protect against the short n-channel transient; longer persisting pulses are reduced in magnitude by a voltage divider, a basically new concept for SEU protection. In such a design, smaller resistors provide SEU tolerance, allowing higher performance, hardened memories. As basis for the LRAM idea, techniques were developed to measure time constants for ion induced voltage transients in conventional static random access memories, SRAM. Time constants of 0.8 and 6.3 nsec were measured for transients following strikes at the n- and p-channel drains, respectively - primary areas of SEU sensitivity. These data are the first transient time measurements on full memory chips and the large difference is fundamental to the LRAM concept. Test structures of the new design exhibit equivalent SEU tolerance with resistors 5-to-10 times smaller than currently used in SRAM. Our advanced transport-plus-circuit numerical simulations of the SEU process predicted this result and account for the LRAM experiments, as well as a variety of experiments on conventional SRAM.

40751 **Epitaxial semiconductor optical interference devices.** Gourley, P.L.; Biefeld, R.M.; Drummond, T.J.; Zipperian, T.E. (Sandia National Labs., Albuquerque, NM (US)). pp 178-188 of Quantum well and superlattice physics. Dohler, G.H.; Schulman, J.N. New York, NY; Springer-Verlag New York Inc. (1987). (CONF-8703197—).

From Quantum well and superlattice physics; Bay Point, FL, USA (23 Mar 1987).

A new class of single-crystal, semiconductor optical interference devices is described. The basic physics governing their operation and materials and growth methods to implement them are summarized. Recent experimental results for epitaxial optical filters, monolithic integration, and tunability are discussed.

40752 **Measurements of diamond-turned copper mirrors at glancing incidence.** Kimura, W.D.; Saito, T.T. (Spectra Technology, Inc., 2755 Northup Way, Bellevue, WA (US)). pp 88-95 of Reflective optics. Korsch, D. Bellingham, WA; SPIE Society of Photo-Optical Instrumentation Engineers (1987). (CONF-870132—).

From OE/LASE '87; Los Angeles, CA, USA (11 Jan 1987).

The results of glancing incidence absorptance measurements performed on diamond-turned copper mirrors are presented. A photoacoustic calorimetry technique is used in which the output from a low power, chopped cw Nd:YAG laser (1.06 μm) is incident upon the mirror at angles of incidence from 0 to 87°, for both s and p-polarizations. Measurements are obtained as a function of the diamond turning groove orientation with respect to the plane of incidence. Minimum absorptance, at high angles of incidence, is achieved with s-polarized light and with the grooves aligned parallel to the plane of incidence. The affects on the absorptance of a large scratch at glancing incidence are also described.

4209 Waste Processing Plants And Equipment

40753 **(DOE/HWP—53) Development of cylinder gas disposal plant: Phase 1, Detailed project planning and concept development report.** Zygmunt, S.J. (Los Alamos National Lab., NM (USA)). Feb 1988. Contract W-7405-ENG-36. 17p. (LA-UR—88-1306). NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88009179/JAW.

The purpose of this program is to develop, test, and document a process for the safe disposal of the contents of leaking, unknown, or damaged gas cylinders. During fiscal year 1988 (FY88), the Los Alamos National Laboratory (LANL) will prepare the equivalent of a Title 1 design for a process to contain problem gas cylinders. Completion of the Title 1 design will allow construction of the prototype process in FY89 and testing in FY90. Preparation of test run and technology transfer documentation will occur in FY91. 3 figs., 2 tabs.

4210 Combustion Systems

REFER ALSO TO CITATION(S) 39070, 39100, 40360

40754 (N—88-21498, pp vp) **Evaluation of structural analysis methods for life prediction.** Kaufman, A.; Saltsman, J.F.; Halford, G.R.; Tong, M. (Sverdrup Technology, Inc., Cleveland, OH (USA)). Apr 1988. NTIS, PC A21/MF A01. (NASA-CP—10010; E—3956; NAS—1.55:10010; CONF-8606138—).

From 3. symposium on nonlinear constitutive relations for high temperature applications; Cleveland, OH, USA (11 Jun 1986).

The utility of advanced constitutive models and structural analysis methods are evaluated for predicting the cyclic life of an air-cooled turbine blade for a gas turbine aircraft engine. Structural analysis methods of various levels of sophistication were exercised to obtain the cyclic stress-strain response at the critical airfoil location. Calculated strain ranges and mean stresses from the stress-strain cycles were used to predict crack initiation lives by using the total strain version of the strain range partitioning life prediction method. The major results are given and discussed.

40755 (N—88-21498, pp vp) **Nonlinear structural analysis of a turbine airfoil using the Walker viscoplastic material model for B1900 + Hf.** Meyer, T.G.; Hill, J.T.; Weber, R.M. Apr 1988. NTIS, PC A21/MF A01. (NASA-CP—10010; E—3956; NAS—1.55:10010; CONF-8606138—).

From 3. symposium on nonlinear constitutive relations for high temperature applications; Cleveland, OH, USA (11 Jun 1986).

A viscoplastic material model for the high temperature turbine airfoil material B1900 + Hf was developed and was demonstrated in a three dimensional finite element analysis of a typical turbine airfoil. The demonstration problem is a simulated flight cycle and includes the appropriate transient thermal and mechanical loads typically experienced by these components. The Walker viscoplastic material model was shown to be efficient, stable and easily used. The demonstration is summarized and the performance of the material model is evaluated.

40756 **(PB—88-192323/XAB) Users guide to POST (Plant Operations Simulation Template).** Kelly, G.E.; Clark, D.R. (National Bureau of Standards, Washington, DC (USA). Building Environment Div.). Mar 1988. 95p. (NBSIR—88/3740). NTIS, PC A05/MF A01.

A non-proprietary simulation template program named POST (Plant Operations Simulation Template) was developed for use with the Lotus 1-2-3® spreadsheet. The template provides for mathematical simulation of central heating/cooling plant equipment including boilers, cooling towers, and centrifugal chillers. It provides methods for configuring a simulation of a specific physical plant, defining operating conditions and time-dependent boundary conditions, running simulations, and graphing simulation results. POST is a flexible and highly portable analytical tool for plant equipment operators and engineers concerned with efficient operation of physical-plant systems. The Users Guide provides an overview of POST, and its companion template program SETUP, which is used to define the characteristics of component models. Information is presented on the menu commands used in POST, and three examples are provided. The examples show how the template program may be used to simulate the performance of a three-boilers heating plant and a central cooling plant consisting of two chillers and a cooling tower. Listings of the actual keystrokes for setting up and running both simulations are included.

40757 **(PB—88-195680/XAB) US/German LIMB technology transfer. Final report, March 1984-June 1986.** Reese, J.L.; Payne, R.; Chughtai, Y. (Energy and Environmental Research Corp., Irvine, CA (USA)). Apr 1988. 25p. NTIS, PC A03/MF A01.

The report gives key findings of a program in which the U.S. EPA participated, sponsored by the Umwelbundesamt (UBA), the German equivalent of the EPA. The UBA program included retrofitting the 700 MWe Weiher III utility boiler of the Saarbergwerke AG with staged-mixing burners for NOx control, and sorbent injection for SOx control. The program was considerably reduced in scope because of restrictions placed on the utility by local environmental officials concerning the classification of the fly ash generated in the process. During the limited testing period, SO_2 emissions were reduced 8-64% depending on Ca/S molar ratio and other operating conditions. An analysis of the test results suggests that the use of more reactive sorbents could increase SO_2 removals to 30 and 60% at a Ca/S ratio of 2, for limestone and calcium hydroxide, respectively.

40758 **(PB—88-195698/XAB) Boilers cofiring hazardous waste: effects of hysteresis on performance measurements.** Licis, I.J.; Mason, H.B. (Environmental Protection Agency, Cincinnati, OH (USA). Hazardous Waste Engineering Research Lab.). Apr 1988. 17p. (EPA—600/D-88/058). NTIS, PC A03/MF A01.

The Hazardous Waste Engineering Research Laboratory (HWERL) has conducted full-scale and pilot-scale boiler testing to determine hazardous-waste destruction and removal efficiencies (DRE's) and other associated boiler-performance parameters during the last five years. The effort investigated several anomalous boiler performance areas dealing with non-steady and off-design boiler operation and included measurements of volatile and semi-volatile organics in the flue gas as well as the fate of some heavy metals introduced into the system. The tests were performed at pilot scale and investigated hysteresis effects, phenomena detected during earlier full-scale testing. These hysteresis effects are defined as the propensity for a boiler to retain certain organic components of the feed material (beyond the duration to a typical sampling protocol), to be released over a longer time frame in an unspecific manner. The effort attempted to identify the presence of these effects beyond random variation, background concentration and sampling problems such as sample contamination. These tests were partially successful at characterizing hysteresis phenomena as well as establishing a qualitative significance of these effects on the accuracy of DRE and other performance measurements.

40759 **(SAND—86-8695) Flow structure and combustion in nonpremixed turbulent bluff-body stabilized flames.** Namazian, M.; Kelly, J.; Schefer, R.W; Johnston, S.C. (Sandia National Labs., Livermore, CA (USA)). Apr 1986. Contract AC04-76DR00789. 25p. (CONF-860804—17). NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88011807/JAW.

From 21. international symposium on combustion; Munich, F.R. Germany (3 Aug 1986).

The flow structures and combustion characteristics of bluff-body stabilized flames were studied using planar flow visualization and direct flame photography. In the planar flow visualization the fuel was seeded with alumina particles and a thin sheet of laser light was used to illuminate the field of view. Mie scattering from the particles in the illuminated plane was then recorded on photographic film. For fixed fuel velocity and low air velocity the particle streak photographs showed a three-dimensional vortical flow structure near the burner face that acted to stabilize the flame at the bluff-body face. For high air velocity, the vortical structures were not observed and the flames were detached. In this case, the fuel jet stagnates on the axis, which stabilizes the flame away from the burner face. Short-exposure Mie scattering images were used to provide detailed information about the turbulent structures that occur in bluff-body flames. These structures can be large, irregular and time varying. It is concluded that instantaneous planar imaging diagnostic techniques are very useful for the characterization of these flames. The experimental results obtained in this study are anticipated to provide new insight into the combustion characteristics of bluff-body flames, insight that should prove useful in developing the next generation of computer models describing such flames. 8 refs., 6 figs., 4 tabs.

40760 **(STF—15A85052) Pellet-fuelled central heating boilers. Operations experiences and combustion engineering/environmental relations at 3 boiler plants.** Utne, Aa.; Oesterboe, E. (SINTEF, Trondheim (Norway)). Aug 1985. 47p. (In Norwegian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88753736/JAW.

The report presents the operating experience from a number of three pellet-fuelled central heating boilers during a period of one year. The combustion conditions depend on the types of boilers and burners etc. By means of monitoring and and favourable operating conditions, the efficiency of the boilers can exeed the normal 70 - 75 % up to 80 - 85 %. The burners used, are relatively new on the market, and undergo permanent tests to better the combustion conditions. 13 drawings, 10 tables.

40761 **(STF—15A86045) Problems concerning use of woodfired boiler systems.** Rosvold, H. (SINTEF, Trondheim (Norway)). Jul 1986. 29p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88753737/JAW.

The report describes problems concerning use of woodfired boiler systems and the questions of causes are evaluated. Lists of the development in numbers of chimney fires are collected, and they clearly show an increase, related to the conversion to wood firing. Inquiries among users of woodfired boilers show that many have problems with desposits of soot in the chimney, smoke in the boiler room and chimney fires. Most of the users need more information and training in how to use the systems. Several serious accidents have occurred, such as steam explosions, and there is a need for better control routines combined with type approvals. Combustion measurements show that none of the systems give a satisfactory combustion under all conditions, and new boiler models have to be developed. 4 drawings, 3 tables.

40762 **Materials evaluation in a simulated FBC environment.** Verma, S.K.; Vesely, E.J. Jr. Houston, TX; National Assoc. of Corrosion Engineers (1987). 22p. (CONF-870314—). National Assoc. of Corrosion Engineers, P.O. Box 218340, Houston, TX 77218.

From Corrosion '87; San Francisco, CA, USA (9 Mar 1987).

The paper describes the unique high temperature, high pressure equipment which has been modified to simulate the operating conditions of the fluidized bed combustor. Results from initial exposure of heat-resistant alloys are discussed in the paper.

40763 **Methods of calibration at a national laboratory.** Anderson, R.L. (Oak Ridge National Lab., Oak Ridge, TN (US)). pp 24-38 of Applications of radiation thermometry. Richmond, J.C.; De Witt, D.P. Philadelphia, PA; ASTM (1985). (CONF-8405340—).

From Symposium on applications of radiation thermometry; Gaithersburg, MD, USA (8 May 1984).

Methods used in the Metrology Research and Development Laboratory at the Oak Ridge National Laboratory for calibration of radiation thermometers are described. Sample calibration procedures are included as well as a description of the calibration information system.

4220 Underground Engineering

REFER ALSO TO CITATION(S) 39118

40764 **(AD-A—191606/3/XAB) Repair, evaluation, maintenance, and rehabilitation research program. Applications of the state of the art of stone columns - liquefaction, local, bearing failure, and example calculations. Final report.** Barksdale, R.D. (Georgia Inst. of Tech., Atlanta (USA). School of Civil Engineering). Dec 1987. 90p. NTIS, PC A05/MF A01.

Stone columns offer one potential technique for rehabilitating the foundations beneath existing structures to withstand both static and earthquake loadings. A detailed discussion of stone columns has been given in a previously published Federal Highway Administration (FHWA) report entitled Design and Construction of Stone Column, Vol I. The present report supplements the FHWA report, presenting earthquake engineering and excess porepressure considerations and giving the previously unpublished appendixes. Seed and Booker's method is presented for estimating the dissipation of excess pore pressure in stone column improved ground during strong-motion earthquakes.

4230 Marine Engineering

40765 **(GKSS—87/E/60) Design criteria for a submarine cogeneration system.** Lucas, J. (GKSS-Forschungszentrum Geesthacht G.m.b.H., Geesthacht-Tesperhude (Germany, F.R.)). 1988. 237p. (In German). NTIS (US Sales Only), PC A11/MF A01. Order Number DE88754003/JAW.

The future development of underwater technology requires a surface-independent energy supply. Based on the energy demand profile for hyperbaric missions of diving welders the concept of an energy supply system has been developed. A comparison of today's available systems shows that the diesel engine is particularly suitable for application in a subsea combined power and heat generating system. For a thermal energy analysis the electrical current parameter characteristic has been evaluated. This characteristic has been found to be an adequate design criterion since it enables the matching of generating structure to consumer structure in a system specific manner. (orig.) With 78 figs., 4 tabs.

40766 **(STF—17A86036) Robotized welding of large offshore constructions.** Neerland, H. (Elektrisitetsforsyningens Forskningsinstitutt, Trondheim (Norway)). Aug 1986. 13p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88753740/JAW.

The paper discribes the possibilities of using robots for multilayer, high quality arc welding in the Norwegian offshore industry. The modifications necessary to create an adaptive robot control and adaptive robot cell control are discussed. Adaptivity in this respect is the ability of the robot controller to adjust the programmed path from signals given by external sensors. The present work done by norwegian research institutes together with a user and a robot producer in order to realize such an adaptive robot welding cell is also described.

40767 **(STF—65A87009) Marine fouling on submerged structures.** Bjerkeli, L.; Skullerud, A.; Moe, G. (SINTEF, Trondheim (Norway)). Jun 1987. 22p. (In Norwegian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88753746/JAW.

The report deals with periphyton fouling for submerged and semi- submerged structures. In connection with the design of bouyant bridges and submerged tobular structures, the consequences from the increased weight of marine fouling and the influencing forces from waves and currents are discussed and presented. In addition, the report discusses the methods of increasing fouling resistance and maintenance. The need for further investigations in this field is specified. 9 drawings, 1 table.

40768 **(STF—71A87035) Progressive collapse analysis of mobile platforms.** Amdahl, J.; Taby, J.; Granli, T. (Norsk Inst. for Luftforskning, Lillestroem). Jul 1987. 14p. (CONF-8706322—1). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88753743/JAW.

From 3. international symposium on practical design of ships and mobile units - PRADS '87; Trondheim, Norway (22 Jun 1987).

The paper presents recent techniques for progressive collapse analysis of offshore structures subjected to damage from accidental loads. A brief description is given of the theory behind a computer program which is based on the idea of using one finite element per structural element. Nonlinear geometric and material behavior is included, the latter by means of plastic hinges and interaction curves for member forces. A model for damaged tubular members is described. It accounts for permanent lateral distortion as well as the effect of a dent on the plastic cross-sectional capacity including dent growth in the post- collapse range. The effect of fire is simulated by taking into consideration thermal expansion and reduction of yield stress and elastic modulus at elevated temperatures. Numerical examples are given for a semi-submersible drilling platform subjected to various explosion damages. It is shown that the platform possesses considerable reserve and residual strength. 10 refs., 9 figs., 1 table.

4240 Pollution Control Equipment

REFER ALSO TO CITATION(S) 39107, 40561, 40758, 41223, 41227, 42419

40769 **(PB—88-202056/XAB) Program to develop engineering data for fabric filtration with integral particle charging and collection in a combined electric and flow field.** Plaks, N. (Environmental Protection Agency, Research Triangle Park, NC (USA). Air and Energy Engineering Research Lab.). 1987. 10p. (EPA—600/J-87/345). NTIS, PC A02/MF A01.

Pub. in proceedings of the Institute of Electrostatics Japan, Vol. 11, No. 6, 445-452(Nov 1987).

This paper discusses an EPA program to develop engineering data for the application of electrostatics to fabric filtration in the form of integral particle charging and collection in a combined electric and flow field, which causes particle deposition to be dominated by electrostatic precipitation rather than by porous-flow collection. A mathematical model was developed to predict the nonuniform deposition of the particulate matter and the relative pressure drop that would result from it. The model predicts both the nonuniform deposition and relative pressure drop with reasonable accuracy. Also investigated as part of the program was the use of pulse energization to equalize the corona currents among a number of electrified bags powered by the same electric power supply. Energizing the bags decreased the penetration of particles $>$ 0.8 micrometer; the trend suggested that it should also be possible to decrease the penetration of particles $<$ 0.8 micrometer.

4250 Power Cycles

40770 **(ANL/CNSV-TM—202) Organic Rankine-Cycle Power Systems Working Fluids Study: Topical report No. 3, 2-methylpyridine/water.** Cole, R.L.; Demirgian, J.C.; Allen, J.W. (Argonne National Lab., IL (USA)). Sep 1987. Contract W-31109-ENG-38. 284p. NTIS, PC A13/MF A01;1; GPO Dep. Order Number DE88012659/JAW.

A mixture of 35 mole percent (mol %) 2-methylpyridine and 65 mol % water was tested at 575, 625, and 675{degree}F in a dynamic loop. Samples of the degraded fluid were chemically analyzed to determine the identities of major degradation products and the quantity of degradation. Computed degradation rates were found to be higher than those for Fluorinol 85 or toluene. For this reason (and other reasons, related to fluid handling), other fluids are recommended as the first choice for service in organic Rankine-cycle systems in preference to 2-methylpyridine/water. 7 refs., 39 figs., 39 tabs.

40771 **(PB—88-864640/XAB) Stirling engines. January 1984-May 1988 (Citations from the NTIS data base). Report for January 1984-May 1988.** (National Technical Information Service, Springfield, VA (USA)). May 1988. 125p. NTIS PC N01/MF N01.

Supersedes PB—87-859088.

This bibliography contains citations concerning Stirling-engine technology. Design, performance testing, development, engine problems, temperature control, computerized simulation, and reliability are considered. Applications of various types of Stirling engines to automobiles, the utilization of solar energy, and an artificial heart system are included. (This updated bibliography contains 237 citations, 63 of which are new entries to the previous edition.)

43 PARTICLE ACCELERATORS

40772 **(FNAL-TM—1518) Muon fluence measurements during the 1987-1988 fixed-target run.** Elwyn, A.J.; Freeman, W.S. (Fermi National Accelerator Lab., Batavia, IL (USA)). 4 Apr 1988. Contract AC02-76CH03000. 24p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88010375/JAW.

Muon fluence and dose equivalent have been observed at the Fermilab site boundary for the MC, MW, and NM beam lines. For MC and MW, the 1987 annual dose equivalents of 2.9 and 1.2 mrem respectively, are less than the 10 mrem site boundary goal. For the new NM beam line, on the other hand, the observed value 13.1 mrem exceeded this operational goal. Indeed, it was this observation that necessitated the additional "spoilers" downstream of the E665 experiment. With these magnets in place, however, the 10 mrem goal should not be in jeopardy for future runs.

40773 **(LBL—24640) Radiation environment in the tunnel of a high-energy proton accelerator at energies near 1 TeV.** McCaslin, J.B.; Sun, R.K.S.; Swanson, W.P.; Cossairt, J.D.; Elwyn, A.J.; Freeman, W.S.; Joestlein, H.; Moore, C.D.; Yurista, P.M.; Groom, D.E. (Lawrence Berkeley Lab., CA (USA)). Dec 1987. Contract AC03-76SF00098. 5p. (CONF-880404—18). NTIS, PC A02/MF A01;1; GPO Dep. Order Number DE88008248/JAW.

From 7. international congress of the International Radiation Protection Association; Sydney, Australia (10 Apr 1988).

Neutron energy spectra, fluence distributions and rates in the FNAL Tevatron tunnel are summarized. This work has application to radiation damage to electronics and research equipment at high energy accelerators, as well as to radiological protection. 7 refs., 4 figs.

4301 Design, Development, And Operation

REFER ALSO TO CITATION(S) 40836, 40839, 40908, 41003, 41013, 41035, 41094, 41795

40774 **(BNL—52114, pp 14-28) Current status of BEPC.** Fang, S. (Institute of High Energy Physics, Beijing (China)). 1987. NTIS, PC A19/MF A01. Order Number DE88008012/JAW. (CONF-8710107—).

From Future perspectives in high energy physics; Upton, NY, USA (5 Oct 1987).

BEPC (Beijing Electron Positron Collider) is the first high energy particle accelerator to be built in China. It consists of four main subsystems: a 1.4-1.55 GeV electron positron linac, a 2.2-2.8 GeV storage ring, a magnetic spectrometer for high-energy experi-

ments, and synchrotron radiation facilities. The designed luminosity is 1.7 x 10^{31} cm^{-2} sec^{-1}. The total budget is 240 million Chinese Yuan (RMB), which is equivalent to about 80 million US dollars in 1984. It was approved by the government in April 1983 and is scheduled to be completed by the end of 1988. There are two purposes for building such a collider. The first one is to do particle physics research, such as charmed particle physics and lepton physics; the second one is to provide synchrotron radiation in VUV, soft X-ray and hard X-ray for scientific research and applications in other sciences.

40775 (BNL—52114, pp 29-38) **Progress on HERA.** Willeke, F. (Deutsches Elektronensynchrotron, Hamburg (West Germany)). 1987. NTIS, PC A19/MF A01. Order Number DE88008012/JAW. (CONF-8710107—).

From Future perspectives in high energy physics; Upton, NY, USA (5 Oct 1987).

The present paper is a progress report on the 30GeV/820GeV electron/proton colliding beam facility HERA which is being built at DESY in Hamburg, Germany. It includes a short presentation of the HERA design. The current stage of the project is described for the various systems. Considerable progress has been made in civil construction. Tunneling is completed. During summer 1987 the cryogenic plant was successfully commissioned. More than a quarter of the dipole magnets of the electron ring have been installed in the tunnel. Mass production is going on or is imminent for the components of the proton ring. A string of three superconducting dipoles and two quadrupoles has been tested successfully at field levels corresponding to 1TeV operation.

40776 (BNL—52114, pp 39-52) **Status report on LEP.** Wyss, C. (CERN, Geneva (Switzerland)). 1987. NTIS, PC A19/MF A01. Order Number DE88008012/JAW. (CONF-8710107—).

From Future perspectives in high energy physics; Upton, NY, USA (5 Oct 1987).

The state of advancement is described for the LEP (Large Electron-Positron) project at CERN, as reached in September 1987. This collider will have an initial beam energy of up to 60 GeV, which will later be raised to nearly 100 GeV by the stepwise addition of superconducting acceleration cavities and by upgrading various machine systems. Four large experiments are in an advanced stage of construction and are expected to be ready for the first machine test in early summer 1989.

40777 (BNL—52114, pp 53-63) **Status of the SLC.** Ruth, R.D. (Stanford Univ., CA (USA)). 1987. NTIS, PC A19/MF A01. Order Number DE88008012/JAW. (CONF-8710107—). Contract AC03-76SF00515.

From Future perspectives in high energy physics; Upton, NY, USA (5 Oct 1987).

The various subsystems of the Stanford Linear Collider and their status are briefly discussed. On October 10, 1987, the SLC ceased commissioning activities to more the Mark II detector into the beam line for the spring physics run. The planned shutdown is for a period of 13 weeks.

40778 (BNL—52114, pp 64-82) **Fermilab tevatron operation and upgrade plans.** Edwards, H.T. (Fermi National Accelerator Lab., Batavia, IL (USA)). 1987. NTIS, PC A19/MF A01. Order Number DE88008012/JAW. (CONF-8710107—).

From Future perspectives in high energy physics; Upton, NY, USA (5 Oct 1987).

The Tevatron is now being operated year round with alternative fixed target and collider runs of about six months' duration interrupted by two-month changeover and maintenance periods. This pattern is expected to continue if funding is sufficient. Statistics for the presently achieved fixed-target and collider operation are presented. The long range Fermilab program requires maintaining a viable physics program into the mid to late 1990's when the SSC will begin operation. The program calls for doubling the integrated luminosity with each succeeding run until peak luminosity of a few x 10^{31}, or an integrated luminosity per run of greater than 10 pb^{-1} is achieved.

40779 (BNL—52114, pp 83-101) **Current status of tristan e^+e^- collider at KEK.** Ozaki, S. (National Lab. for High Energy Physics, Ibaraki (Japan)). 1987. NTIS, PC A19/MF A01. Order Number DE88008012/JAW. (CONF-8710107—).

From Future perspectives in high energy physics; Upton, NY, USA (5 Oct 1987).

The Transposable Ring Intersecting Storage Accelerators in Nippon (TRISTAN) is presently the world's highest energy e^+e^- colliding beam facility. TRISTAN will allow Japan to join others in high energy physics research at the bona fide energy frontier. The idea of the TRISTAN in a form of three-storage-ring complex was born during 1973. Construction of TRISTAN in the present form was approved and funded by the Japanese Government as a five-year project starting in the Japanese fiscal year 1981. The actual construction began on November 19th of that year with a ground breaking for the TRISTAN accumulation ring. Five years later, TRISTAN achieved e^+e^- collision at the world's highest center-of-mass energy of 50 GeV on November 14th, 1986, and on November 19th, exactly five years from the date of the ground breaking, one of the TRISTAN detectors, VENUS, which had been at the collision point since the beginning of the commissioning run has succeeded in observing a clean large angle Bhabha scattering at the collision energy of 48 GeV, then the world's highest collision energy. On December 13, the first hadronic event was observed also by VENUS. It is interesting to note that a q anti q event at this energy indeed give a jet-like appearance on the event display. Another TRISTAN detector, AMY, by a collaboration of groups from the USA, China, Korea and Japan was rolled into the collision point on November 23, and started to observed collision events also in the subsequent commissioning and engineering runs.

40780 (BNL—52114, pp 102-115) **Accelerating and storage complex (UNK). Experimental research program.** Tyurin, N.E. (Institute for High Energy Physics, Serpukhov (USSR)). 1987. NTIS, PC A19/MF A01. Order Number DE88008012/JAW. (CONF-8710107—).

From Future perspectives in high energy physics; Upton, NY, USA (5 Oct 1987).

The project of the IHEP Accelerating and Storage Complex (UNK) envisages the following operational modes: (1) Acceleration of protons up to 3 TeV at the intensity 6 x 10^{14} ppp for fixed target experiments. (2) Proton-proton colliding beams with energy $\sqrt{S}$=6 TeV and luminosity 4 x 10^{32} cm^{-2} sec^{-1}. Prototype work on the basic components of the machine systems will be over this year and the superconducting magnet design will also be chosen. Orders for manufacturing various systems have been put into industry. The construction of a special workshop for production of superconducting magnets at IHEP will be over very soon.

40781 (BNL—52114, pp 167-178) **SSC project status.** Tigner, M. 1987. NTIS, PC A19/MF A01. Order Number DE88008012/JAW. (CONF-8710107—).

From Future perspectives in high energy physics; Upton, NY, USA (5 Oct 1987).

The expectation that new phenomena crucial to understanding the fundamental interactions must occur at the 1 TeV energy scale motivates the proposed superconducting super collider (SSC), a proton-proton collider with 20 TeV beams and 10^{33} cm^{-2} s^{-1} luminosity. Three years of research and development - on the basic dipole magnets, quench protection, correction elements, superconductor strand and cable, cryogenics, accelerator physics, and conventional facilities - culminated in March 1986, in a detailed conceptual design. Both short and long model magnets have been built to test design modifications. The first three long model magnets to be tested met thermal, mechanical, electrical, and quench protection criteria, and showed encouraging field strength results. Further work on beam dynamics led to the decision to change from a 60° phase advanced per cell to 90°.

40782 (BNL—52114, pp 179-199) **Large hadron collider in the LEP tunnel.** Brianti, G.; Burnod, L. (CERN, Geneva (Switzerland)). 1987. NTIS, PC A19/MF A01. Order Number DE88008012/JAW. (CONF-8710107—).

From Future perspectives in high energy physics; Upton, NY, USA (5 Oct 1987).

A summary and an up-dated version of the studies for the CERN Large Hadron Collider (LHC) are presented. It first outlines the main interesting features of LHC and gives the performance predictions; then the three major items, the lattice, the superconducting magnets and the cryogenics are briefly described; finally one considers if possible limitations could come from the existing injector or from collective effects and if LEP and LHC are compatible with an efficient exploitation of the two machines.

40783 (BNL—52114, pp 200-217) **Research and development for a CERN linear collider.** Schnell, W. (CERN, Geneva (Switzerland)). 1987. NTIS, PC A19/MF A01. Order Number DE88008012/JAW. (CONF-8710107—).

From Future perspectives in high energy physics; Upton, NY, USA (5 Oct 1987).

At CERN work on linear colliders rapidly gained momentum from 1985 onwards. Indeed, a Long Range Planning Committee initiated by the CERN Council and chaired by C. Rubbia had decided on its first meeting that one of its three advisory panels was to explore the possibility of an e^+e^- collider at TeV energies, the two other panels being concerned with the Large Hadron Collider (LHC) in the LEP tunnel (chaired by G. Brianti) and the physics issues (chaired by J. Mulvey). The panel e^+e^- colliders (under the chairmanship of K. Johnsen) adopted the name of CERN Linear Collider (CLIC) for the subject of its study, made the tentative choice of 2 TeV for the centre of mass energy and proceeded to initiate its own study work - at CERN and in collaboration with other laboratories - in addition to reviewing the results obtained elsewhere. The panel issued its report in May 1987. As part of the Long Range Planning Committee's report this Report from the Advisory panel on the Prospects for e^+e^- Linear Colliders in the TeV Range was submitted to the CERN Council in June where it was very positively received. Much encouragement is coming from ECFA and from the high-energy physics community at large who examined the physics potential of future accelerators - LHC and CLIC - at a workshop in La Thuile in January 1987.

40784 (BNL—52114, pp 219-231) **Electron-Positron linear collider R & D program at KEK.** Kimura, Y.; Takata, K.; Yoshioka, M. (National Lab. for High Energy Physics, Ibaraki (Japan)). 1987. NTIS, PC A19/MF A01. Order Number DE88008012/JAW. (CONF-8710107—).

From Future perspectives in high energy physics; Upton, NY, USA (5 Oct 1987).

It is generally recognized that the study of elementary particle interactions should be extended to the multi-TeV region for penetration of the frontier described by the Standard Model. This necessarily demands development of new accelerators, both hadron colliders and lepton colliders, of energies a few to tens of TeV. In Japan, the High Energy Committee, high energy scientist's organization in Japan, showed in 1986 the directions in which to go after TRISTAN to pursue physics in the new energy frontier. Those are summarized as follows. (1) Immediate initiation of R & D efforts to investigate a possible construction of an electron-positron linear collider of the beam energy 0.5 - 1 TeV as a home-based facility. (2) Promotion of the international collaboration which will lead to the participation in experiments to be done by super-high energy hadron colliders as SSC and LHC.

40785 (BNL—52114, pp 232-243) **Linear collider research at SLAC.** Ruth, R.D. (Stanford Univ., CA (USA)). 1987. NTIS, PC A19/MF A01. Order Number DE88008012/JAW. (CONF-8710107—). Contract AC03-76SF00515.

From Future perspectives in high energy physics; Upton, NY, USA (5 Oct 1987).

The Accelerator Department at SLAC is to design the next generation linear collider by about 1990, so that the construction might start in the mid 1990's +/- a couple of years. The general parameters of such a machine are presented. The center of mass energy is taken to be about 1 TeV and the luminosity in the range 10^{33}-$10^{34}cm^{-2}sec^{-1}$. These two parameters force the design to be a non-simple extension of the SLC. The other requirements in Table 1 are somewhat arbitrary but allow the machine to be built on a Stanford site with reasonable wall-plug power. The technology used in the machine must be realizable by the early 1990's.

40786 (BNL—52114, pp 244-266) **Physical foundations for linear colliders.** Balakin, V.E.; Brezhnev, O.N.; Mikhailichenko, A.A.; Novokhatski, A.V.; Smirnov, V.P.; Solyak, N.A. (Institute of Nuclear Physics, Novosibirsk (USSR)). 1987. NTIS, PC A19/MF A01. Order Number DE88008012/JAW. (CONF-8710107—).

From Future perspectives in high energy physics; Upton, NY, USA (5 Oct 1987).

The new principal solution of the high energy problem is the creation of a facility with colliding linear electron-positron beams. In this case synchrotron radiation is negligible and the cost of the facility is proportional to the ultimate energy. However, in spite of seemed simplicity of the proposal, there are many complicated problems to be solved. In particular, to achieve the equivalent luminosity it is necessary to accelerate high - intense beams of very small emittance, so to get the cross section area of the order of 1 mkm^2 at the collision point. Also the value of the accelerating gradient in linear accelerators should be very high; 100 MeV/m as the total facility length is determined by this value.

40787 (BNL—52114, pp 269) **Looking beyond BEPC.** Fang, S. (Institute of High Energy Physics, Beijing (China)). 1987. NTIS, PC A19/MF A01. Order Number DE88008012/JAW. (CONF-8710107—).

From Future perspectives in high energy physics; Upton, NY, USA (5 Oct 1987).

China is a developing country. The current policy is to develop the national economy by making the best use of limited resources. China cannot be expected to increase the fund for basic research in a short period of time. Therefore, it is not very clear about what to do next when the BEPC project is completed. However, it is certain that collaboration with the international community of high energy physics will be strengthened. Practical experience has been accumulated in the course of BEPC construction. Some Chinese industries have improved their skills and technologies in fabricating the subcontracted components of the collider. What is more, quite a number of accelerator and experimental physicists and engineers were trained. All these have had a solid foundation for future international collaboration.

40788 (BNL—52114, pp 270-274) **Personal views on future cooperation in accelerator construction.** Lederman, L.M. (Fermi National Accelerator Lab., Batavia, IL (USA)). 1987. NTIS, PC A19/MF A01. Order Number DE88008012/JAW. (CONF-8710107—).

From Future perspectives in high energy physics; Upton, NY, USA (5 Oct 1987).

The superconducting super collider (SSC) is having an adverse affect on the construction of and funding for other accelerators in the US. The cost and scope of high beam luminosity, high energy accelerators necessitates cooperation between nations on funding, siting, and construction. Construction of a post-SSC accelerator must have the cooperation of most, if not all, the developed and developing nations; it should be a world accelerator.

40789 (BNL—52114, pp 275-279) **Report of the CERN long-range planning committee.** Mulvey, J.H. (Univ. of Oxford (England)). 1987. NTIS, PC A19/MF A01. Order Number DE88008012/JAW. (CONF-8710107—).

From Future perspectives in high energy physics; Upton, NY, USA (5 Oct 1987).

The conclusions reached by the CERN long range planning committee can be summarized briefly as follows: LEP should be completed to its design energy of ~ 200 GeV. The existence at CERN of (i) a high-quality injector complex with record performance, and (ii) the LEP tunnel and related infrastructures, makes it extremely attractive to explore the 1 TeV energy domain with the LHC. As the lower energy of the LHC compared to the SSC can be partially compensated with the help of higher luminosity, the LRPC concludes that the LHC offers the most cost-effective way for the world's high energy physics community to achieve early access to energies $\simeq$ 1 TeV in the constituent center of mass. CERN must intensify immediately its research and development on: (i) the possibility of attaining on a large scale 10 Tesla fields with existing superconductors at a lower operating temperature; (ii) the two in one magnet configuration; and (iii) detectors, to ensure that

they can be operated efficiency at the highest luminosities. Exploration of the 1 TeV energy domain requires both a hadron collider in the multi-TeV region and an e^+e^- collider with about 2 TeV in the center of mass.

40790 (BNL—52114, pp 281-290) **Personal view for future high energy physics facilities.** Nishikawa, T. (National Lab. for High Energy Physics, Ibaraki (Japan)). 1987. NTIS, PC A19/MF A01. Order Number DE88008012/JAW. (CONF-8710107—).

From Future perspectives in high energy physics; Upton, NY, USA (5 Oct 1987).

After TRISTAN, the highest priority should be placed on research to explore a new energy frontier, with the center of mass energy from a few hundred GeV to a few tens of TeV. In order to achieve this purpose: initiate immediate research and development efforts for an electron-positron collider in the TeV region, which is to be constructed as a possible home-based facility; promote international collaborative experiments using facilities such as the SSC. Some projects of immediate concern are after the completion of the current TRISTAN project, the energy of the main ring should be increased further. An effort should be made for a possible future operation of the TRISTAN complex as a low energy, high luminosity electron-positron collider. The intensity of the 12 GeV KEK PS should be increased. Experiments in non-accelerator particle physics should be promoted.

40791 (BNL—52114, pp 291-298) **Perspective on future accelerators.** Richter, B. (Stanford Univ., CA (USA)). 1987. NTIS, PC A19/MF A01. Order Number DE88008012/JAW. (CONF-8710107—). Contract AC03-76SF00515.

From Future perspectives in high energy physics; Upton, NY, USA (5 Oct 1987).

The goal at SLAC is to complete the R & D required for the next linear collider (NLC) in time to start the construction of the NLC in the mid-90's +/- a couple of years. It is assumed that the goals of the European, Japanese and Soviet researchers are identical. Thus it should be possible to work out a method to avoid duplication and to move the whole effort along faster and more economically than if one group tried to do it all. The proposal is simply to do the R & D internationally. Make it a mix of coordinated and collaborative work, for it will all move faster that way and there are no secrets in accelerator physics anyway. Governments and circumstances in the future will determine where and when a machine is built. Arguments about that can be postponed for later and cooperation can occur now, for that cooperation will best serve all long-range interests.

40792 (BNL—52114, pp 299-308) **Future cooperation in accelerator construction.** Schopper, H. (CERN, Geneva (Switzerland)). 1987. NTIS, PC A19/MF A01. Order Number DE88008012/JAW. (CONF-8710107—).

From Future perspectives in high energy physics; Upton, NY, USA (5 Oct 1987).

A variety of machines with complementary potentialities are needed: pp colliders (high energies can be achieved, however dirty events); e^+e^- colliders (high energies difficult to achieve, but clean events); ep colliders (to continue previous programs of electron-, muon-, and neutrino-scattering experiments at higher energies); fixed target p machines (for neutrino, hyperon beams, etc.). To convince governments to finance such a varied program and in order to demonstrate international collaboration it seems necessary to the author that the high energy physics community present a coherent world scenario. Such a scenario must not only take care of the different types of accelerators, but should include also time scales with proper staging. An extended interregional collaboration will very likely not only have to cover the construction of projects but also their common exploitation, including both operation of experiments and machines.

40793 (BNL—52114, pp 309-311) **International collaboration in high energy physics facilities.** Soergel, V. (Deutsches Elektronen-Synchrotron, Hamburg (West Germany)). 1987. NTIS, PC A19/MF A01. Order Number DE88008012/JAW. (CONF-8710107—).

From Future perspectives in high energy physics; Upton, NY, USA (5 Oct 1987).

The virtues of ep colliders are discussed in view of HERA. They have a common virtue with e^+e^- colliders in producing very clean reactions - between a quark and an electron - and yet the virtue of a proton machine as well: providing high center-of-mass energy. Nevertheless, the future must rely on a multiplicity of approaches, and not on the proverbial world machine. International collaboration will be necessary on e^+e^-, pp, ep, and perhaps heavy ion colliders, as well as on detectors. Assuming the various machines are technically feasible, how will they realize them from a political and financial point of view? First, large facilities can presumably only be realized by international collaboration. This must involve three kinds of partners: the Laboratory proper for constructing the facility, the host government, and the collaborating country (and Laboratory).

40794 (BNL—52114, pp 312-313) **Directions in future cooperation.** Tigner, M. 1987. NTIS, PC A19/MF A01. Order Number DE88008012/JAW. (CONF-8710107—).

From Future perspectives in high energy physics; Upton, NY, USA (5 Oct 1987).

Basic research in general, and particle physics in particular, influences culture in at least three ways. Most importantly, the results of the research strongly affect their understanding and appreciation of the physical world and their place in it. The results of the research and the technology developments created to carry out the research increase economic wealth, inspire youth to devote themselves to scientific careers and train cadres of scientific and technical works will contribute to the technical economy. In addition, the pursuit of the science and accompanying technology creates a medium of cultural exchange which transcends barriers of language, ethnic culture and ideology.

40795 (BNL—52114, pp 314-315) **Topics for discussion of collaboration in constructing the future generation of accelerators.** Tyurin, N.E. (Institute for High Energy Physics, Serpukhov (USSR)). 1987. NTIS, PC A19/MF A01. Order Number DE88008012/JAW. (CONF-8710107—).

From Future perspectives in high energy physics; Upton, NY, USA (5 Oct 1987).

At present high energy physics is developing on a regional basis. New facilities are being designed and constructed in Western Europe, the USA, Japan and the USSR. The regional basis for the development of high energy physics assumes wide joint participation of physicists and experts from different regions in the regional projects, both at the stage of preparing and carrying out experiments and of machine design. The physicists of the USSR take part in the experimental program at the Tevatron, LEP, and HERA, including their contribution to the construction of experimental setups. The USSR, in turn, always welcomes and supports participation of the other regions in the preparation and carrying out of experiments, in particular at UNK. The USSR could participate in the research and development program for the LHC and SSC, for CLIC and superconducting projects and, in turn, will be ready to receive experts to take part in the UNK and VLEPP projects.

40796 (BNL—52114, pp 319-326) **Survey of the work of the ICFA panel on superconducting magnets and cryogenics.** Brianti, G. (CERN, Geneva (Switzerland)). 1987. NTIS, PC A19/MF A01. Order Number DE88008012/JAW. (CONF-8710107—).

From Future perspectives in high energy physics; Upton, NY, USA (5 Oct 1987).

A Workshop was held to review in depth the state of the art for the design and construction of accelerator magnets throughout the world, the prospects for future development of superconductors and various aspects of large systems and of cryogenics. A secondary goal was to decide on future activities of the Review Panel.

40797 (BNL—52114, pp 327-338) **Design study on high energy accelerator magnets with complete arch coils by special keystone cables.** Hirabayashi, H.; Ishibashi, K. (National Lab. for High Energy Physics, Ibaraki (Japan)). 1987. NTIS, PC A19/MF A01. Order Number DE88008012/JAW. (CONF-8710107—).

From Future perspectives in high energy physics; Upton, NY, USA (5 Oct 1987).

In the near future, superconducting magnets with a small aperture will be required for high energy storage accelerators. When coils are designed to arch of themselves over a small beam pipe, it simplifies the magnet construction both in the winding procedure and in the field quality control. Fabrication of these coils requires cables with large keystone angles. A new structure of braid-in-strands is devised to make these cables. A design study is performed to make clear the characteristics of the magnets that are wound by these cables. A magnet is designed in this study and the straight section of this magnet has been fabricated as a preliminary test before constructing a whole magnet.

40798 (BNL—52114, pp 339-342) **Report on the work of the ICFA panel on beam dynamics.** Dikansky, N.S.; Keil, E. (CERN, Geneva (Switzerland)). 1987. NTIS, PC A19/MF A01. Order Number DE88008012/JAW. (CONF-8710107—).

From Future perspectives in high energy physics; Upton, NY, USA (5 Oct 1987).

This report of the ICFA Beam Dynamics Panel to ICFA covers the period from November 1986 till October 1987. It contains brief summaries of two panel meetings, and a report on the first Advanced Beam Dynamics Workshop. The approval of ICFA is sought for two further workshops, to be held in 1988 and 1989, and for the creation of a Beam Dynamics School.

40799 (BNL—52114, pp 343-352) **Report on the activities of the panel on future instrumentation innovation and development.** Ekeloef, T. (Univ. of Uppsala (Sweden)). 1987. NTIS, PC A19/MF A01. Order Number DE88008012/JAW. (CONF-8710107—).

From Future perspectives in high energy physics; Upton, NY, USA (5 Oct 1987).

The ICFA Panel on Future Instrumentation Innovation and Development since it was set up in 1985 has been operating with the following basic aims: to create new channels of communication for information on High Energy Physics Instrumentation to stimulate new and more activity in this field in order to meet the experimental challenge of the planned future colliders and also of the forthcoming non-accelerator experiments; and to stimulate the involvement of all regions of the world in Experimental High Energy Physics for general reasons of scientific culture and in particular in order to increase the amount of human and material resources channeled to the field of High Energy Physics. With these basic aims the Panel has organized the following activities which are now well under way: the ICFA Instrumentation School, the ICFA Instrumentation Bulletin, and the ICFA Review of detector Properties. Lately a few other activities have been initiated. They are: facilitating international computer net-work mail communication; publishing a list of HEP Instrumentation Workshops and Conferences; and assisting in redistribution of used HEP instrumentation from big to small labs.

40800 (BNL—52114, pp 353-359) **Report of the new acceleration schemes panel.** Sessler, A.M. (Lawrence Berkeley Lab., CA (USA)). 1987. NTIS, PC A19/MF A01. Order Number DE88008012/JAW. (CONF-8710107—).

From Future perspectives in high energy physics; Upton, NY, USA (5 Oct 1987).

The acceleration schemes panel has been concerned with novel accelerator schemes. Perhaps just a few comments are in order. They can limit themselves to just a few highlights since there have been recently - in the last five years - six conferences, each with lengthy proceedings, on the subject. The Plasma-laser accelerator have achieved a gradient $\sim$ 1. GeV/m and electrons have actually been accelerated. Furthermore a long uniform plasma has been created. The principle of the wakefield accelerator has been demonstrated. A photocathode has been achieved with a peak current of more than 100 A, at 1 MeV, and with a rms normalized emittance of 20 x 10^{-6} π m rad. Gradient studies have realized an accelerating field of more than 300 MV/m, while power source work has resulted in a 60 MW gyrocon at 7.5 GHz, a 70 MW relativistic klystron at 8.6 GHz, and a 1.8 GW FEL at 35 GHz. Collider studies have begun to make the next linear collider (NLC) a real thing, while the Two-Beam approach is being actively pursued, also, for the NLC.

40801 (FNAL/C—88/55) **QA [quality assurance] at Fermilab; the hermeneutics of NQA-1.** Bodnarczuk, M. (Fermi National Accelerator Lab., Batavia, IL (USA)). Jun 1988. Contract AC02-76CH03000. 4p. (CONF-880631—21). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88012678/JAW.

From 29. annual meeting of the Institute of Nuclear Materials Management; Las Vegas, NV, USA (26 Jun 1988).

This paper opens with a brief overview of the purpose of Fermilab and a historical synopsis of the development and current status of quality assurance (QA) at the Laboratory. The paper subsequently addresses some of the more important aspects of interpreting the national standard ANSI/ASME NQA-1 in pure research environments like Fermilab. Highlights of this discussion include, what is hermeneutics and why are hermeneutical considerations relevant for QA, a critical analysis of NQA-1 focussing on teleological aspects of the standard, a description of the hermeneutical approach to NQA-1 used at Fermilab which attempts to capture the true intents of the document without violating the deeply ingrained traditions of quality standards and peer review that have been foundational to the overall success of the paradigms of high-energy physics.

40802 (ISN—87-64) **Studies of Lear antiproton deceleration: radiofrequency quadripole or synchrotron.** Iazzourene, F. (Grenoble-1 Univ., 38 (France). Inst. des Sciences Nucleaires). Jun 1987. 135p. (In French). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88752430/JAW.

The aim of this work is to study a radiofrequency quadrupole (RFQ) and a synchrotron as decelerating systems for antiprotons extracted from the Low Energy Antiproton Ring (LEAR) at CERN. Antiprotons at energies lower than those available from LEAR are need by some experiments, eg. the measurement of the mass difference between protons and antiprotons with 10/sup -9/ accuracy, using a Smith and Princeton spectrometer, and the measurement of gravitation on the antiprotons, using a trap. Depending on the LEAR performances, one can conclude that the RFQ is suitable for the experiment on the gravitation, and the synchrotron, owing to its electron cooling system, is a better solution for the experiment on the mass difference measurement, because of the very small acceptance of the spectrometer.

40803 (ITEF—163(1987)) **Ways for improvement of the LIU-5/5000 linear induction accelerator parameters.** Bobylev, V.I.; Kapchinskij, I.M.; Lapitskij, Yu.Ya.; Plotnikov, V.K.; Chuvilo, I.V. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1987. 28p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703312/JAW.

The reasons of limitaions to increase the beam current and improve the quality of beam in the electron linear induction accelerator LIU-5/5000 are studied. The necessity to increase the voltage in the gaps of the electron gun, increase the diameter of the cathode and aperture of the drift tube, accuracy of axial symmetry electron gun current-carrying elements and accuracy of gun fabrication are shown. Stabilization of beam parameters require a new high voltage modulators. Different versions of the linac modernization with the use of transformers with cores of 430 and 600 mm are studied. Technical possibilities at several versions of high voltage modulators are discussed. 9 refs.; 5 figs.

40804 (KEK—87-13, pp 77-86) **High-output particle accelerator plan of Tokyo Institute of Technology and current status of heavy ion linear accelerator.** Hattori, Toshiyuki. (Tokyo Inst. of Tech. (Japan). Research Lab. of Nuclear Reactor). Sep 1987. (In Japanese). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88780097/JAW. (CONF-8706325—).

From Meeting on high-power, high-frequency power sources; Oho, Japan (4 Jun 1987).

The first part of this report describes the high-output particle accelerator plan of Tokyo Institute of Technology, centering on the research plan, structure of the high-output particle accelerator and

application experiment system, and preliminary study with the high-output particle accelerator. The research covers development of new materials by ion beam implantation, effect of heavy ion beam on nuclear fusion materials, damage and activation of material by fast neutron, heat removal from high-temperature load surface, evaluation of soundness of first wall during plasma disruption, evaporation and condensation of liquid metal lithium film flow, linear accelerator for heavy ion inertia nuclear fusion, and development of high-temperature superconducting accelerator cavity. The accelerator system consists of an RFQ-type first stage and IH- or IHQ-type second stage, and is equipped with two ion sources. It can accelerate particles, including carbon and nitrogen, up to 7.5 MeV. A preliminary study on high-output particle accelerators is planned to be performed in cooperation with The University of Tokyo. The second half of the report briefly outlines some improvements and modifications made in the acceleration cavities. (Nogami, K.).

40805 (KEK—87-13, pp 145-152) **Current status of development of lasertron.** Yoshioka, Masakazu. (Tokyo Univ., Tanashi (Japan). Inst. for Nuclear Study). Sep 1987. (In Japanese). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88780097/JAW. (CONF-8706325—).

From Meeting on high-power, high-frequency power sources; Oho, Japan (4 Jun 1987).

Following its establishment in April 1986, the Linear Collider Study Group started a five-year program with the objectives as follows: (1) development of an acceleration tube with an acceleration magnetic field strength of 100 MV/m or greater, (2) development of a high-output pulsed-microwave source to drive the acceleration tube, and (3) research in beam dynamics, centering on beam-beam effect, low emittance beam, emittance growth and final focusing system, and (4) alignment of the acceleration tube and control of beam at collision point. Requirements for microwave sources for linear collider are outlined first. The second part of the report is focused on a 2 MW lasertron which is currently being tested. Gallium arsenide is selected as material for the photo-cathode. This is a P+ semiconductor and Zn is used as dopant. This GaAs photo-cathode is high in quantum efficiency and can be reactivated by heat cleaning. Major parameters of the laser, 'frequency doubled modelocked Nd: YAG laser' supplied by Nippon Electric Co., Ltd., are described. A simulation study is made to investigate the beam motion near the cathode and anode. Some results of a diode test are shown and applications of the lasertron are also discussed. (Nogami, K.).

40806 (LA-UR—88-1537) **Ground test accelerator control system software.** Burczyk, L.; Dalesio, R.; Dingler, R.; Hill, J.; Howell, J.A.; Kerstiens, D.; King, R.; Kozubal, A.; Little, C.; Martz, V.; Rothrock, R.; Sutton, J. (Los Alamos National Lab., NM (USA)). 1988. Contract W-7405-ENG-36. 8p. (CONF-880695—1). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88010922/JAW.

From 1. European particle accelerator conference; Rome, Italy (7 Jun 1988).

The GTA control system provides an environment in which the automation of a state-of-the-art accelerator can be developed. It makes use of commercially available computers, workstations, computer networks, industrial I/O equipment, and software. This system has built-in supervisory control (like most accelerator control systems), tools to support continuous control (like the process control industry), and sequential control for automatic startup and fault recovery (like few other accelerator control systems). Several software tools support these levels of control: a real-time operating system (VxWorks) with a real-time kernel (VRTX), a configuration database, a sequencer, and a graphics editor. VxWorks supports multitasking, fast context-switching, and preemptive scheduling. VxWorks/VRTX is a network-based development environment specifically designed to work in partnership with the UNIX operating system. A database provides the interface to the accelerator components. It consists of a run time library and a database configuration and editing tool. A sequencer initiates and controls the operation of all sequence programs (expressed as state programs). A graphics editor gives the user the ability to create color graphic displays showing the state of the machine in either text or graphics form. 11 refs., 2 figs.

40807 (LBL—24478) **SuperHILAC: Heavy-ion linear accelerator: Summary of capabilities, facilities, operations, and research.** McDonald, R.J. (ed.). (Lawrence Berkeley Lab., CA (USA)). Sep 1987. Contract AC03-76SF00098. 58p. NTIS, PC A04/MF A01; GPO Dep. Order Number DE88008390/JAW.

This report consists of a description of the accelerator facilities and a review of research programs being conducted there. Lists of SuperHILAC researchers and publications are also given.

40808 (NIIEFA-P-V—0754) **Parametric series of unified induction linear accelerators.** Vakhrushin, Yu.P.; Demskij, M.I.; Zhestkov, S.N.; Ehrmel', V.Eh. (Nauchno-Issledovatel'skij Inst. Ehlektrofizicheskoj Apparatury, Leningrad (USSR)). 1987. 31p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703461/JAW.

On the basis of analysis of the present state and prospects for application of high-intense accelerated charged particle beams the fields of most rational use of induction linear accelerators (ILA) are determined. Such basic parameters as pulse length, accelerated current amplitude and pulse frequency lie in the basis of accelerator structural classification. The range of possible values of ILA basic parameters is tabulated, that permitted to outline four accelerator modifications, satisfying the requirements of possible considered applications. Unification of ILA main systems is considered, characteristics of the unified systems are determined. Principles and ways of future development of induction linear accelerators are established. Maximal unification of ILA basic systems will promote a better organization of accelerator production, increase of their performances, and reduce expences for ILA development. 37 refs.; 6 tabs.

40809 (SLAC—329) **Opportunities and requirements for experimentation at high energy e+ e/sup {minus}/ collider.** Ahn, C.; Baltay, C.; Barklow, T.L.; Burchat, P.R.; Burke, D.L.; Cooper, A.R.; Dib, C.; Feldman, G.J.; Gunion, J.F.; Haber, H.E. (Stanford Linear Accelerator Center, Menlo Park, CA (USA)). May 1988. Contract AC03-76SF00515;AC03-76SF00098. 113p. NTIS, PC A06/MF A01; 1; GPO Dep. Order Number DE88012660/JAW.

Over the past fifteen years of high-energy physics, electron-positron annihilation has been the most productive of all reactions probing the fundamental interactions. The e+ e/sup {minus}/ annihilation process is unique in offering at the same time copious production of novel particles, low backgrounds from more conventional physics, and the most efficient use of the energy which an accelerator provides. These features have allowed the detailed characterization of the charm and bottom quark-antiquark systems and the unambiguous discovery of gluon jets---the crucial ingredients in the establishment of Quantum Chromodynamics as the correct theory of the strong interactions---as well as the discovery of the tau lepton and confirmation of the weak and electromagnetic properties of all the quarks and leptons at high energy. Over the past few years, experiments will begin at SLC and LEP, and we anticipate new discoveries from the detailed study of the Z° resonance. It is time, then to begin to think out how one might continue this mode experimentation to still higher energies. This document is the report of a committee convened by the Director of SLAC, Burton Richter, to set out the major physics goals of an e+ e/sup {minus}/ collider in the energy range 600 GeV-1 TeV, corresponding to the next feasible step in accelerator technology. The committee was charged with the task of outlining the main experiments that such a collider might carry out and the requirements which those experiments place on the accelerator design. 106 refs., 105 figs., 13 tabs.

40810 (SLAC-PUB—4539) **SLC beam line error analysis using a model-based expert system.** Lee, M.; Kleban, S. (Stanford Linear Accelerator Center, Menlo Park, CA (USA)). Feb 1988. Contract AC03-76SF00515. 3p. (CONF-8806166—3). NTIS, PC A02/MF A01;1; GPO Dep. Order Number DE88012727/JAW.

From 4. international working conference on statistical and scientific database management; Rome, Italy (21 Jun 1988).

Commissioning particle beam line is usually a very time-consuming and labor-intensive task for accelerator physicists. To aid in commissioning, we developed a model-based expert system that identifies error-free regions, as well as localizing beam line errors. This paper will give examples of the use of our system for the SLC commissioning. 8 refs., 5 figs.

40811 **(SLAC-PUB—4610) Recent progress at the Stanford Linear Collider.** Bambade, P.S. (Stanford Linear Accelerator Center, Menlo Park, CA (USA)). Apr 1988. Contract AC03-76SF00515. 18p. (CONF-8709294—1; CONF-8709295—1). NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88010683/JAW.

From 19. Ecole de Physique des Particules; Marseille-Luminy, France (7 Sep 1987).

A status report on SLC commissioning is given, with special emphasis on recent progress in the Arcs and Final Focus. 50 refs.

40812 (ZfK—592, pp 108-113) **Investigation on physis of fission at the meson factory of the Institute for Nuclear Research of the Academy of Sciences of the USSR.** Stavisskij, Yu.Ya. (AN SSSR, Moscow. Inst. Yadernykh Issledovanij). Apr 1986. (In Russian). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88780092/JAW. (CONF-8511312—).

From 15. international symposium on nuclear physics - nuclear fission; Gaussig, German D.R. (11 Nov 1985).

The Moscowian meson factory established at the Institute for Nuclear Research of the Academy of Sciences of the USSR is presented. The main directions of investigations of nuclear fission induced by proton, neutron, pion and muon beams are illustrated. Specially following items are discussed: 1) low excitation energy range, 2) fission induced by intermediate protons, 3) fission induced by pions and muons, 4) investigation of nuclear processes and nuclear properties, and 5) fission cross sections and secondary neutron spectra useful in nuclear energetics.

40813 **U.S. accelerator research program for heavy-ion fusion.** Polansky, W.M. (U.S. Dept. of Energy, Office of Basic Energy Sciences, Washington, DC (US)). *Fusion Technology;* **13**: No. 2, 201-206(Feb 1988).

The U.S. heavy-ion fusion program emphasizes research and development (R and D) on linear induction accelerators. This strategy emerged in 1983, after the U.S. Department of Energy established the heavy-ion fusion accelerator research (HIFAR) program to acquire an appropriate data base for future decisions on heavy-ion inertial fusion. Since that time, HIFAR has advanced the understanding of high-current ion beam transport, and accelerator technology through laboratory-scale experiments and supporting theoretical studies. Although each program element will continue to contribute to the HIFAR data base over the next few years, present accelerator experiments cannot supply sufficient data to adequately satisfy the program objective. Consequently, HIFAR is approaching a transition between the research and accelerator demonstration phases. The history, status, and short-term plans of HIFAR are examined. The program structure, review of the technical status, and introduction of a proposed R and D program that can minimally meet the HIFAR objective are discussed.

40814 **Design of a charge sensitive preamplifier on high resistivity silicon.** Radeka, V.; Rehak, P.; Rescia, S.; Gatti, E.; Longoni, A.; Sampietro, M.; Holl, P.; Struder, L.; Kemmer, J. (Brookhaven Nat. Lab., Upton, NY (US)). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* **35**: No. 1, 155-159(Feb 1988). (CONF-871006—).

From 34. nuclear science symposium and 19. nuclear power systems symposium; San Francisco, CA, USA (21 Oct 1987).

A low noise, fast charge sensitive preamplifier was designed on high resistivity, detector grade silicon. It is built at the surface of a fully depleted region of n-type silicon. This allows the preamplifier to be placed very close to a detector anode. The preamplifier uses the classical input cascode configuration with a capacitor and a high value resistor in the feedback loop. The output stage of the preamplifier can drive a load up to 20rhoF. The power dissipation of the preamplifier is 13mW. The amplifying elements are "Single Sided Gate JFETs" developed especially for this application. Preamplifiers connected to a low capacitance anode of a drift type detector should achieve a rise time of 20ns and have an equivalent noise charge (ENC), after a suitable shaping, of less than 50 electrons. This performance translates to a position resolution better than 3μm for silicon drift detectors.

40815 **Radiation-hardened microelectronics for accelerators.** Gover, J.E.; Fischer, T.A. (Div. 400 and 2154 Respectively, P.O. Box 5800, Sandia National Labs., Albuquerque, NM (US)). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* **35**: No. 1, 160-165(Feb 1988). (CONF-871006—).

From 34. nuclear science symposium and 19. nuclear power systems symposium; San Francisco, CA, USA (21 Oct 1987).

Ionization and displacement phenomena in semiconducting materials are reviewed. How these basic effects lead to changes in the electrical characteristics of transistors and diodes and the functionality of integrated circuits are summarized. The fundamental radiation limits for various semiconductor technologies are summarized. Recommendations and precautions are given regarding the applicability of various microelectronic technologies to different accelerator environments.

40816 **The pulsed amplitude unit for the SLC.** Rolfe, J.; Browne, M.J.; Jobe, R.K. (Stanford Linear Accelerator Center, Stanford Univ., Stanford, CA (US)). pp 786-788 of Proceedings of the 1987 IEEE particle accelerator conference: Accelerator engineering and technology. Lindstrom, E.R.; Taylor, L.S. Piscataway, NJ; IEEE Service Center (1987). (CONF-870302—). Contract AC03-76SF00515.

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

There is a recurring requirement in the SLC for the control of devices such as magnets, phase shifters, and attenuators on a beam-by-beam basis. The Pulsed Amplitude Unit (PAU) is a single width CAMAC module developed for this purpose. It provides digitally programmed analog output voltages on a beam-by-beam basis. Up to 32 preprogrammed values of output voltage are available from the single analog output of the module, and any of these values can be associated with any of the 256 possible SLC beam definitions. A 12-bit Analog-to-Digital converter (ADC) digitizes an analog input signal at the appropriate beam time and stores it in a buffer memory. This feature is normally used to monitor the response of the device being controlled by the PAU at each beam time. Initial application of the PAU at is as part of the system that controls the output of Klystorns in the SLC. The PAU combines several different functions in a single module. In order to accommodate these functions in a single width CAMAC module, field programmed logic is used extensively. Field Programmable Logic Arrays, Programmed Array Logic, and a Field Programmable Logic Sequencer are employed.

40817 **The SLC control system - Status and development.** Phinney, N.; Shoaee, H. (Stanford Linear Accelerator Center, Stanford Univ., Stanford, CA (US)). pp 789-790 of Proceedings of the 1987 IEEE particle accelerator conference: Accelerator engineering and technology. Lindstrom, E.R.; Taylor, L.S. Piscataway, NJ; IEEE Service Center (1987). (CONF-870302—). Contract AC03-76SF00515.

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

The SLC control system is installed and operational in the full SLC through the Linac, Damping Rings, Positron Source, Arcs and Final Focus. The system now includes a host VAX 11/785, a development VAX 11/780, 4 VAX workstations, a distributed network of 70 microprocessors, and about 270 Camac crates with more than 4000 modules. The micros are used for control and monitoring of the hardware, for pulse-to-pulse feedback, and for consoles (COWs). High level model-driven host software provides a variety of tools for beam setup, optimization, diagnosis, and stabilization. This paper summarizes the current status and projects under development.

40818 **Tuning loop control system for the Fermilab Debuncher DRF1 cavities.** Zagel, J.R.; Watts, T.M.; Smolucha, J.M.; Bharadwaj, V.K. (Fermi National Accelerator Lab., P.O. Box 500, Batavia, IL (US)). pp 794-796 of Proceedings of the 1987 IEEE particle accelerator conference: Accelerator engineering and technology. Lindstrom, E.R.; Taylor, L.S. Piscataway, NJ; IEEE Service Center (1987). (CONF-870302—).

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

The DRF1 cavities are tuned by heating the beam pipe. When beam is present a phase detector compares the cavity RF drive signal with its RF output. The output of the phase detector is digitized and phase errors are read by a Z80 microprocessor which then calculates the heater settings. A low cost thermocouple temperature monitoring system provides a means of keeping the cavities approximately in tune when beam is not present. The thermocouple system incorporates an inexpensive 1MBit Manchester encoded digital link to collect digitized temperatures up to 1000 meters away using twisted pair cable. The hardware and software that effect the tuning loop control are discussed.

40819 **Workstation consoles for SLC.** Bogart, J.; Hunter, A.; Sullenberger, M.; Kleban, S.; Phinney, N.; Spencer, N. (Stanford Linear Accelerator Center, Stanford Univ., Stanford, CA (US)). pp 797-799 of Proceedings of the 1987 IEEE particle accelerator conference: Accelerator engineering and technology. Lindstrom, E.R.; Taylor, L.S. Piscataway, NJ; IEEE Service Center (1987). (CONF-870302—). Contract AC03-76SF00515.

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

A workstation console based on the DEC VAXstation GPx has been developed for the SLC control system. The three video monitors (touchpanel, color graphics display and terminal screen) of the original SLC console are replaced by four windows on the single workstation monitor, and standalone diagnostic programs may run concurrently. In order to minimize software effort and operator training, it was a design requirement that higher-level control and applications code, particularly that in the SLC Control Program, be identical whether the program executed on the MicroVAX or on the host VAX. The code for the graphics is necessarily different for the MicroVAX, as is the lower-level code used to access resources resident only in the host. A server program on the host acts as intermediary between programs running on the workstation and these resources.

40820 **Heavy ion program at BNL: AGS, RHIC.** Barton, D.S. (AGS Dept., Brookhaven National Lab., Associated Universities, Inc., Upton, NY (US)). pp 804-808 of Proceedings of the 1987 IEEE particle accelerator conference: Accelerator engineering and technology. Lindstrom, E.R.; Taylor, L.S. Piscataway, NJ; IEEE Service Center (1987). (CONF-870302—).

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

With the recent commissioning of fixed target, heavy ion physics at the AGS, Brookhaven National Laboratory (BNL) has embarked on a long range program in support of relativistic heavy ion research. Acceleration of low mass heavy ions (up to sulfur) to an energy of about 14.5 GeV/nucleon is possible with the direct connection of the BNL Tandem Van de Graaff and AGS accelerators. When completed, the new booster accelerator will provide heavy ions over the full mass range for injection and subsequent acceleration in the AGS. BNL is now engaged in an active R and D program directed toward the proposed Relativistic Heavy Ion Collider (RHIC). The results of the first operation of the low mass heavy ion program will be reviewed, and future expectations discussed. The expected performance for the heavy ion operation of the booster is described and finally, the current status and outlook for the RHIC facility is presented.

40821 **The Bevalac upgrade project.** Alonso, J.R.; Dwinell, R.D.; Feinberg, B.; Frias, R.; Gough, R.A.; Howard, D.R.; Hunt, D.B.; Krebs, G.F.; Krupnick, J.T.; Lewis, S.A. (Lawrence Berkeley Lab., Univ. of California, Berkeley, CA (US)). pp 854-856 of Proceedings of the 1987 IEEE particle accelerator conference: Accelerator engineering and technology. Lindstrom, E.R.; Taylor, L.S. Piscataway, NJ; IEEE Service Center (1987). (CONF-870302—). Contract AC03-76SF00098.

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

This paper describes a proposed upgrade of the Bevalac accelerator complex in which the present Bevatron is replaced with a modern, strong-focussing 17 T-m synchrotron. This new ring is designed to accelerate all ions throughout the periodic table with intensities 100 to 1000 times higher than the present Bevatron. It will also provide a substantially improved beam spill structure and will reduce operating costs. A fast extraction capability can be used to inject a future heavy ion storage ring. Pulse-to-pulse switching of energy and ions species is an important goal. The existing injectors, shielding, experimental facilities and utilities of the present Bevalac will remain substantially intact.

40822 **Simulations of the Fermilab main ring.** Gerig, R.; Pruss, S.; Turkot, F. (Fermi National Accelerator Lab., P.O. Box 500, Batavia, IL (US)). pp 1123-1125 of Proceedings of the 1987 IEEE particle accelerator conference: Accelerator engineering and technology. Lindstrom, E.R.; Taylor, L.S. Piscataway, NJ; IEEE Service Center (1987). (CONF-870302—).

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

Tracking programs are routinely being used in the design of future accelerators. The authors report on the use of such a program in understanding an existing accelerator. The problems of obtaining useful magnetic measurements from an operational machine are first discussed, as well as alternative methods of specifying the fields if these measurements are not available. The simulation results are compared with measurements made on the Main Ring with particular emphasis on the sources and corrections of the driving terms for the third-integer resonance lines.

40823 **Systematic study of the dependence of lattice dynamics on cell structure parameters.** Leemann, B.T.; Forest, E. (SSC Central Design Group, Lawrence Berkeley Lab., Berkeley, CA (US)). pp 1143-1145 of Proceedings of the 1987 IEEE particle accelerator conference: Accelerator engineering and technology. Lindstrom, E.R.; Taylor, L.S. Piscataway, NJ; IEEE Service Center (1987). (CONF-870302—).

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

The Conceptual Design Report (CDR) of the SSC foresees the following cell structure parameters: 60 deg. phase advance, 10 dipole magnets (1 = 16.54 m), 4 cm coil diameter. In order to study systematically the dependence of the lattice dynamics on these 3 parameters, a large number of lattices based on cells with different cell structure parameters have been designed and their linear apertures determined, whereby the following ground rules had been followed: 1) the lattices are built entirely from regular cells; 2) in order to account for the chromaticity produced by the IRs, a corresponding number of cells with ideal dipole magnets are included; 3) all lattices contain the same number of realistic (with random multipole errors) CDR dipole magnets. Linear aperture results obtained by tracking as well as from analytic calculations are tabulated and discussed.

40824 **Error-finding and error-correcting methods for the start-up of the SLC.** Lee, M.J.; Clearwater, S.H.; Kleban, S.D.; Selig, L.J. (Stanford Linear Accelerator Center, Stanford Univ., Stanford, CA (US)). pp 1334-1336 of Proceedings of the 1987 IEEE particle accelerator conference: Accelerator engineering and technology. Lindstrom, E.R.; Taylor, L.S. Piscataway, NJ; IEEE Service Center (1987). (CONF-870302—). Contract AC03-76SF00515.

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

During the commissioning of an accelerator, storage ring, or beam transfer line, one of the important tasks of an accelerator physicist is to check the first-order optics of the beam line and to look for errors in the system. Conceptually, it is important to distinguish between techniques for finding the machine errors that are the cause of the problem and techniques for correcting the beam errors that are the result of the machine errors. In this paper the authors limit their presentation to certain applications of these two methods for finding or correcting beam-focus errors and beam-kick errors that affect the profile and trajectory of the beam respectively. Many of these methods have been used successfully in the commissioning of SLC systems. In order not to waste expensive beam time they have developed and used a beam-line simulator to test the ideas that have not been tested experimentally. To save valuable physicist's time they have further automated the beam-kick error-finding procedures by adopting methods from the field of artificial intelligence to develop a prototype expert system. The authors' experience with this prototype has demonstrated the usefulness of expert systems in solving accelerator control problems. The expert system is able to find the same solutions as an expert physicist but in a more systematic fashion. The methods used in these procedures and some of the recent applications are described in this paper.

40825 **Transition jump system for the Fermilab Booster.** Merz, W.; Ankenbrandt, C.; Koepke, K. (Fermi National Accelerator Lab., Batavia, IL (US)). pp 1343-1345 of Proceedings of the 1987 IEEE particle accelerator conference: Accelerator engineering and technology. Lindstrom, E.R.; Taylor, L.S. Piscataway, NJ; IEEE Service Center (1987). (CONF-870302—).

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

A transition-jump system recently installed in the Fermilab Booster is described. Early results of the commissioning are presented.

40826 **RFQ1 control and data acquisition system.** Chidley, B.G. (Atomic Energy of Canada Ltd., Research Co., Chalk River Nuclear Labs., Chalk River, Ontario K0J 1J0 (US)). pp 637-639 of Proceedings of the 1987 IEEE particle accelerator conference: Accelerator engineering and technology. Lindstrom, E.R.; Taylor, L.S. Piscataway, NJ; IEEE Service Center (1987). (CONF-870302—).

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

The RFQ1 control and data acquisition system uses an IBM PC-AT personal computer controlling a special purpose computer built by Taurus Computer Products Inc. which contains the input-output interface boards. The special purpose computer maintains a real time data table, drives the output lines, and completes control loops. The PC provides the user interface to adjust variable set points, monitor system activity and perform data logging functions. System control and data logging may continue as a background task while the PC runs other user programs. A description of the control system is given with details of operation with the RFQ1 injector system.

40827 **Operation of a 3 MeV ampere intensity dc electron recirculation system.** Sundquist, M.L.; Adney, J.A.; Dehais, S.J.; Cline, D.B.; Larson, D.J.; Anderson, D.R.; Mills, F.E. (National Electrostatics Corp., 7540 Graber Road, Middleton, WI (US)). pp 316-318 of Proceedings of the 1987 IEEE particle accelerator conference: Accelerator engineering and technology. Lindstrom, E.R.; Taylor, L.S. Piscataway, NJ; IEEE Service Center (1987). (CONF-870302—).

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

The authors report their observations on the initial operation at 2.2 MeV of the Pelletron electron recirculation system originally designed as a source for electron cooling of GeV-energy antiproton beams, along with final data from test bench operation at energies up to 40 keV. Test bench results indicate that the collector efficiency is better than 99.99%, and that the multi-element cathode in the electron gun produces negligible halo.

40828 **Lattice design of HISTRAP: Heavy ion storage ring for atomic physics.** Lee, I.Y.; Martin, J.A.; McGrory, J.B.; Milner, W.T.; Olsen, D.K.; Young, G.R. (Physics Div., Oak Ridge National Lab., Oak Ridge, TN (US)). pp 310-312 of Proceedings of the 1987 IEEE particle accelerator conference: Accelerator engineering and technology. Lindstrom, E.R.; Taylor, L.S. Piscataway, NJ; IEEE Service Center (1987). (CONF-870302—).

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

HISTRAP, a Heavy-Ion Storage Ring for Atomic Physics, is a proposed 46.8-m-circumference synchrotron-cooling-storage ring optimized to accelerate, cool, decelerate, and store beams of highly charged very-heavy ions at energies appropriate for advanced atomic physics research. This four-fold symmetrical ring has a maximum bending power of 2 Tm. It has achromatic bends and uses quadrupole triplets for focusing.

40829 **RADLAC-II accelerator beam experiments.** Mazarakis, M.G.; Leifeste, G.T.; Clark, R.S.; Ekdahl, C.A.; Frost, C.A.; Hasti, D.E.; Johnson, D.L.; Miller, R.B.; Poukey, J.W.; Prestwich, K.R. (Sandia National Labs., Albuquerque, NM (US)). pp 908-910 of Proceedings of the 1987 IEEE particle accelerator conference: Accelerator engineering and technology. Lindstrom, E.R.; Taylor, L.S. Piscataway, NJ; IEEE Service Center (1987). (CONF-870302—).

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

A pulsed transmission line linear accelerator, RADLAC II, composed of an injector plus six post-accelerating gaps was built and successfully operated. A 3-4 MV foilless diode injector was used and an annular 30-40 kA, relativistic electron beam was produced and further accelerated through the post-accelerating gaps. The final beam energy was close to the sum of injector and gap voltages and equal to ~16 MeV. The pulsed power drivers, the accelerator, and the beam transport system are described. Experimental results are presented and discussed.

40830 **High-brightness H/sup -/ accelerators.** Jameson, R.A. (Los Alamos National Lab., Los Alamos, NM (US)). pp 903-907 of Proceedings of the 1987 IEEE particle accelerator conference: Accelerator engineering and technology. Lindstrom, E.R.; Taylor, L.S. Piscataway, NJ; IEEE Service Center (1987). (CONF-870302—).

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

Neutral particle beam (NPB) devices based on high-brightness H/sup -/ accelerators are an important component of proposed strategic defense systems. The basic rational and R and D program are outlined and examples given of the underlying technology thrusts toward advanced systems. Much of the research accomplished in the past year is applicable to accelerator systems in general; some of these activities are discussed.

40831 **Design and status of the AGS booster accelerator.** Forsyth, E.B.; Lee, Y.Y. (Brookhaven National Lab., Associated Universities Inc., Upton, NY (US)). pp 867-869 of Proceedings of the 1987 IEEE particle accelerator conference: Accelerator engineering and technology. Lindstrom, E.R.; Taylor, L.S. Piscataway, NJ; IEEE Service Center (1987). (CONF-870302—).

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

A booster accelerator for the AGS was originally proposed in 1983 as an accumulator for polarized protons and shortly after as a means of also increasing the AGS proton intensity. It was later proposed to also design it for use as a pre-accelerator for heavy ions from the tandem Van de Graaff so that all ions up to Au (mass 197) could be fully stripped and accelerated in the AGS. Without the Booster the maximum mass that can be directly injected into the AGS is sulfur (mass 32). The Booster is thus an essential component in the chain which will permit the AGS to act as a heavy ion injector into the proposed Relativistic Heavy Ion Collider (RHIC). The diverse requirements for the Booster impose many difficult constraints and compromises on the design. Prior to the

start of construction in November, 1985, a preliminary design had emerged for a fast-cycling machine with a circumference one-quarter of the AGS using a separated function FODO lattice.

40832 **ZAP and its application to the optimization of synchrotron light source parameters.** Zisman, M.S. (Lawrence Berkeley Lab., Univ. of California, Berkeley, CA (US)). pp 991-995 of Proceedings of the 1987 IEEE particle accelerator conference: Accelerator engineering and technology. Lindstrom, E.R.; Taylor, L.S. Piscataway, NJ; IEEE Service Center (1987). (CONF-870302—).

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

The design of electron storage rings for the production of synchrotron radiation has become increasingly sophisticated in recent years. To assist in the optimization of such storage rings, a new, user-friendly code to treat the relevant collective phenomena, called ZAP, has been written at LBL. The code is designed primarily to carry out parameter studies of electron storage rings, although options for protons or heavy ions are included where appropriate. In this paper, the authors first describe the contents of the code itself, and then illustrate, via selected examples, how the collective effects treated by ZAP manifest themselves in the new generation of synchrotron light sources.

40833 **Aperture determination and operation simulation in large storage rings.** Schachinger, L. (SSC Central Design Group, Lawrence Berkeley Lab., Berkeley, CA (US)). pp 986-990 of Proceedings of the 1987 IEEE particle accelerator conference: Accelerator engineering and technology. Lindstrom, E.R.; Taylor, L.S. Piscataway, NJ; IEEE Service Center (1987). (CONF-870302—).

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

Dynamic aperture is a well known and much used tool for collider design. However, for the SSC with its strong magnetic nonlinearities it is necessary to examine the nonlinear behavior of the beam more closely to minimize cost while assuring essentially linear behavior during routine operations. Thus the concept of linear aperture has been developed, and extensively applied in the design of the SSC. In order to explore this concept in a realistic situation, accelerator experiments have been proposed at the Tevatron which will test the parameters of the linear aperture definition chosen.

40834 **The design of the accelerating gaps for the linear induction accelerator RADLAC II.** Shope, S.L.; Mazarakis, M.G.; Miller, R.B.; Poukey, J.W. (Sandia National Labs., Albuquerque, NM (US)). pp 978-980 of Proceedings of the 1987 IEEE particle accelerator conference: Accelerator engineering and technology. Lindstrom, E.R.; Taylor, L.S. Piscataway, NJ; IEEE Service Center (1987). (CONF-870302—).

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

In high current (50 kA) linear induction accelerators, the accelerating gaps can excite large radial oscillations. A gap was designed that minimized the radial oscillations and reduced potential depressions. The envelope equation predicted radial oscillation amplitudes of 1 mm which agreed with experimental measurements.

40835 **Dose-voltage dependence for HELIA/HERMES III bremsstrahlung diodes.** Sanford, T.W.L.; Halbleib, J.A.; Poukey, J.W.; Heath, C.E.; Mock, R. (Sandia National Labs., P.O. Box 5800, Albuquerque, NM (US)). pp 931-933 of Proceedings of the 1987 IEEE particle accelerator conference: Accelerator engineering and technology. Lindstrom, E.R.; Taylor, L.S. Piscataway, NJ; IEEE Service Center (1987). (CONF-870302—).

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

The relation D α IV/sup 2.65/ is widely used to estimate the on-axis radiation dose rate, D, downstream of an optimized bremsstrahlung target as a function of diode voltage, V, for flash x-ray sources. This relation is valid only for pencil beams. For diodes having beams with finite spatial and angular extent, the power 2.65 is reduced. This reduction is evaluated via the MAGIC and CYLTRAN codes for diodes operating on the projected 20 MV HERMES III and existing 3 MV HELIA accelerators. For HERMES III, a power of 2.2 is obtained for nearfield exposures using a fixed converter optimized at 20 MV. For HELIA, a power of 1.8 is obtained when the change in electron flow with voltage is also taken into account. This voltage dependence, together with the measured voltage and current waveforms on HELIA is used to calculate the expected temporal shape of the radiation pulse. The shape is consistent with that measured using a PIN diode.

4302 Beam Dynamics, Field Calculations, And Ion Optics

REFER ALSO TO CITATION(S) 40677, 40802, 40977, 40978, 40980, 40981, 40982, 40986, 41011, 41095, 42309

40836 **(CEA-CONF—9208) Superconducting Helix loaded cavity for heavy ion acceleration.** Ramstein, G.; Cauvin, B.; Fouan, J.P. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Service de Physique Nucleaire a Basse Energie). 1987. 21p. (In French). (CONF-8707175—). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88753902/JAW.

From Biannual meeting of the French Physical Society; Strasbourg, France (6 Jul 1987).

Half-wave helix loaded structures have been designed to increase the mass range of heavy ions which will be accelerated by the CEN Saclay superconducting accelerator. In this paper we shall list the main characteristics of these resonators; especially, the quality factor and the energy gain per charge measured with a /sup 12/C beam. The important advantages of these new structures are the broadness of the transit time factor curve which allows us to accelerate low velocity beams with a sufficient efficiency, and the simplicity of mechanical design which requires only two helix welds. We shall also give the performances achieved by the series of resonators which will be mounted into two of the six machine cryostats. The new superconducting accelerator will provide the first beams at the end of this year.

40837 **(CERN-EP—87-171) Electron cooling of stored ions.** Wolf, A. (European Organization for Nuclear Research, Geneva (Switzerland)). 22 Sep 1987. 38p. (CONF-8706176—7). NTIS (US Sales Only), PC A03; 1; GPO Dep. Order Number DE88012594/JAW.

From Workshop and symposium on the physics of low energy, stored, and trapped particles; Stockholm, Sweden (14 Jun 1987).

The experimental conditions of electron cooling in storage rings with magnetically confined electron beams are discussed. Particular attention is paid to 'fast' electron cooling, which will be important for low-energy ion storage rings. Measurements of cooling rates and of equilibrium ion beam temperatures are reviewed. A short report is given on the recent development work for electron cooling at the CERN Low-Energy Antiproton Ring (LEAR), and on related electron beam diagnostic experiments. Conclusions are drawn in view of electron cooling at future ion storage rings. 49 refs., 4 figs., 1 tab.

40838 **(DOE/ER—40336-1) [Simulation of ultra-low emittance electron rings]: Progress report, March 1, 1987-May 31, 1988.** Hand, L.N. (Cornell Univ., Ithaca, NY (USA). Dept. of Physics). 27 Apr 1988. Contract FG02-87ER40336. 3p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE88010432/JAW.

This report briefly discusses the development of a simulation program for low emittance storage rings and how it has been extended to include multi-bunch wake field effects, as well as single bunch effects in accelerator cavities. (LSP)

40839 **(DOE/ER/40216—5-Rev.) Accelerator research studies: Annual technical report.** (Maryland Univ., College Park (USA)). 5 Mar 1988. Contract AC05-85ER40216. 158p. NTIS, PC A08/MF A01. Order Number DE88008236/JAW.

This paper discusses accelerator research at the University of Maryland. The three task studies contained in this paper are: Instabilities and Emittance Growth in Periodic Focusing Systems for Intense Beams; Collective Ion Acceleration by Intense Electron Beams and Pulse Powered Plasma Focus; and Microwave Sources and Parameter Scaling for High-Frequency e$^+$e/sup {minus/} Supercollider Linacs.

40840 **(DOE/ER/40423—04-P8) How big is a cyclotron?.** Brown, L.S. (Washington Univ., Seattle (USA). Dept. of Physics). 1988. Contract AS06-88ER40423. 4p. NTIS, PC A02/MF A01;1; GPO Dep. Order Number DE88009579/JAW.

The radius of the orbit of a particle of given energy in a laboratory cyclotron is computed in terms of the Bohr radius of the hydrogen atom a_0 and the fine structure constant α.

40841 **(FNAL/C—88/56) Polarization calculations for electron storage rings.** Mane, S.R. (Fermi National Accelerator Lab., Batavia, IL (USA)). May 1988. Contract AC02-76CH03000. 21p. (CONF-8711197—1). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88012220/JAW.

From Workshop on polarization in LEP; Geneva, Switzerland (9 Nov 1987).

A computer program called SMILE has been developed to calculate the equilibrium polarization in a high-energy electron storage ring. It can calculate spin resonances to arbitrary orders, in principle. Results of polarization calculations are shown for a variety of storage ring models, to elucidate various aspects of the behaviour of the polarization, such as the effects of machine symmetry, beam energy spread, and transverse momentum recoils, etc. Reasonable agreement is obtained with some experimental data from measurements at SPEAR. 12 refs., 12 figs.

40842 **(FNAL/C—88/69) Coherent betatron instability in the Tevatron.** Bogacz, S.A.; Harrison, M.; Ng, K.Y. (Fermi National Accelerator Lab., Batavia, IL (USA)). 9 Jun 1988. Contract AC02-76CH03000. 4p. (CONF-880695—10). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88012677/JAW.

From 1. European particle accelerator conference; Rome, Italy (7 Jun 1988).

The coherent betatron instability was first observed during the recent 1987-88 Tevatron fixed target run. In this operating mode 1000 consecutive bunches are loaded into the machine at 150 GeV with a bunch spacing of 18.8 {times} 10^{-9} sec (53 MHz). The normalized transverse emittance is typically 15 π {times} 10^{-6} m rad in each plane with a longitudinal emittance of about 1.5 eV-sec. The beam is accelerated to 800 GeV in 13 sec. and then it is resonantly extracted during a 23 sec flat top. As the run progressed the bunch intensities were increased until at about 1.4 {times} 10^{10} ppb (protons per bunch) we experienced the onset of a coherent horizontal oscillation taking place in the later stages of the acceleration cycle (>600 GeV). This rapidly developing coherent instability results in a significant emittance growth, which limits machine performance and in a catastrophic scenario it even prevents extraction of the beam. In this paper we will present a simple analytic description of the observed instability. We will show that a combination of a resistive wall coupled bunch effect and a single bunch slow head-tail instability is consistent with the above observations. Finally, a systematic numerical analysis of our model (growth-time vs chromaticity plots) points to the existence of the ≥ 1 slow head-tail modes as a plausible mechanism for the observed coherent instability. This last claim, as mentioned before, does not have conclusive experimental evidence, although it is based on a very good agreement between the measured values of the instability growth-time and the ones calculated on the basis of our model. 4 refs., 3 figs.

40843 **(FNAL-TM—1521) Toroidal resonant impedances in RHIC.** Ng, K.Y. (Lawrence Berkeley Lab., CA (USA); Fermi National Accelerator Lab., Batavia, IL (USA)). Apr 1988. Contract AC02-76CH03000;AC03-76SF00098. 6p. (CONF-880335—4). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88012723/JAW.

From Workshop on the relativistic heavy ion collider performance; Upton, NY, USA (21 Mar 1988).

In a toroidal beam pipe, a wave with a particular azimuthal variation travels with different speeds depending on the distance from the center of the toroidal ring. For example, if the beam travels with velocity βc at a toroidal radius R, the electromagnetic wave traveling with the beam will have a velocity $r\beta c/R$ at a radius r. If this velocity reaches c, this electromagnetic wave can also propagate. This wave will interact back with the beam and a resonance occurs. These resonances are positioned at azimuthal harmonics. For a perfectly conducting pipe wall, a beam at a particular radius r from the center of the toroidal ring may excite on infinitely sharp resonance at one azimuthal harmonic n/sub r/, which is an integer. The resonance at the next harmonic n/sub r'/ = n/sub r/ + 1 will be excited by the beam particles ar radius r' which is very close to r. However, for a beam pipe with wall resistivity, each of these resonances will have a azimuthal harmonic width of Δn which is of the order of 100. What the beam particle sees will be a broad resonance which, in principle, can drive a "microwave" growth. For this reason, the study of toroidal resonances is meaningful and important. 5 refs., 1 tab.

40844 **(GANIL-A—87-02) Equilibrium orbits in a cyclotron with four separated sectors.** Chabert, A.; Gendreau, G.; Cazoll, V. (Grand Accelerateur National d'Ions Lourds (GANIL), 14 - Caen (France)). Jun 1987. 18p. (In French). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88752450/JAW.

In each sector of the cyclotron energy and field being defined, a static equilibrium orbit is got around which an accelerated equilibrium orbit oscillates. Different cases were simulated on computer in applying them to the CSSO project of Ganil. Results are presented on 7 figures.

40845 **(GSI—88-07) Schottky noise analysis in linear accelerators.** Oguri, Y.; Mueller, R.W. (Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (Germany, F.R.)). Mar 1988. 31p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88754152/JAW.

An application of Schottky noise analysis is theoretically presented for the diagnosis of intense beams in linacs. Induced currents by betatron/synchroton oscillations of particles as well as mismatched-envelope oscillations are calculated by applying different models. The induced currents are analytically Fourier-analyzed. Resulting power spectra show some stochastic peaks which reflect basic parameters of these oscillations.

40846 **(ITEF—131(1987)) Nonlinear Coulomb effects in transport channels.** Zenkevich, P.R.; Korolev, A.P. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1987. 25p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703308/JAW.

Using the perturbation method the formulae for the particle beam phase volume increase under the nonlinear field effect are derived. Expressions for potential of proper Coulomb field of the beam with elliptical symmetry are obtained. It is shown that in a short transport channel the phase volume Coulomb increase is defined by the beam perveance, initial distribution function and the channel structure. Growth of phase volume in periodic channels is also investigated. 8 refs.

40847 **(LA-UR—88-1655) Longitudinal phase-space formulas for stationary buckets.** Colton, E. (Los Alamos National Lab., NM (USA)). 1988. Contract W-7405-ENG-36. 6p. (CONF-880335—2). NTIS, PC A02/MF A01;1; GPO Dep. Order Number DE88010930/JAW.

From Workshop on the relativistic heavy ion collider performance; Upton, NY, USA (21 Mar 1988).

The purpose of this paper is to put commonly used formulas of beam bunching phase space into the proceedings. 3 refs., 1 fig., 1 tab. (LSP)

40848 **(LBL—23939) LATTICE{hor←ellipsis}a beam transport program.** Staples, J. (Lawrence Berkeley Lab., CA (USA)). Jun 1987. Contract AC03-76SF00098. 50p. NTIS, PC A03/MF A01. Order Number DE88008402/JAW.

LATTICE is a computer program that calculates the first order characteristics of synchrotrons and beam transport systems. The program uses matrix algebra to calculate the propagation of the betatron (Twiss) parameters along a beam line. The program draws on ideas from several older programs, notably Transport and Synch, adds many new ones and incorporates them into an interactive, user-friendly program. LATTICE will calculate the matched functions of a synchrotron lattice and display them in a number of ways, including a high resolution Tektronix graphics display. An optimizer is included to adjust selected element parameters so the beam meets a set of constraints. LATTICE is a first order program, but the effect of sextupoles on the chromaticity of a synchrotron lattice is included, and the optimizer will set the sextupole strengths for zero chromaticity. The program will also calculate the characteristics of beam transport systems. In this mode, the beam parameters, defined at the start of the transport line, are propagated through to the end. LATTICE has two distinct modes: the lattice mode which finds the matched functions of a synchrotron, and the transport mode which propagates a predefined beam through a beam line. However, each mode can be used for either type of problem: the transport mode may be used to calculate an insertion for a synchrotron lattice, and the lattice mode may be used to calculate the characteristics of a long periodic beam transport system.

40849 **(NIIEFA-P-V—0729) DINA program pckage for simulation of high-current beam dynamics in linear induction accelerator.** Tikhomirov, A.S. (Nauchno-Issledovatel'skij Inst. Ehlektrofizicheskoj Apparatury, Leningrad (USSR)). 1986. 10p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88701692/JAW.

PL/1 (O) program package for analysis of beam parameters in linear induction accelerator is developed. Calculation of the beam self-fields is carried out in the moving or laboratory system using the Green functions or the Gauss theorem. Accelerating voltage pulses are given in tables. Injection modes can change in a pulse depending on the initial energy. External magnetic fields are given in a table form on the coordinate axis or on the lattice nodes. Program package testing carried out has demonstrated its high accuracy and speed of response. 6 refs.; 3 figs.

40850 **(NIIEFA-P-V—0737) Computer simulation of stationary states of nonlinear axial-symmetric beams.** Tikhomirov, A.S. (Nauchno-Issledovatel'skij Inst. Ehlektrofizicheskoj Apparatury, Leningrad (USSR)). 1986. 7p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88701693/JAW.

Self-consisten algorithm and PL/1(0) program of analyzing stationary states of nonlaminar axial-symmetric high-current beams has been developed. Calculation of beam eigenfields is conducted according to Gauss theorem and Ampere law. Distribution of current density in random cross-sections is calculated by the method of compressed current tubes. The system of motion equations is integrated simultaneously for all trajectories by Runge-Kutta method of the fifth order in combination with field equations. The calculations resulted to phase pictures of the beam and distribution of current density in random cross-sections. 10 refs.; 2 figs.

40851 **(SLAC-PUB—4627) Symplectic maps for accelerator lattices.** Warnock, R.L.; Ruth, R.; Gabella, W. (Stanford Linear Accelerator Center, Menlo Park, CA (USA)). May 1988. Contract AC03-76SF00515. 13p. (CONF-8803122—1). NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88012734/JAW.

From Workshop on symplectic integration; Los Alamos, NM, USA (19 Mar 1988).

We describe a method for numerical construction of a symplectic map for particle propagation in a general accelerator lattice. The generating function of the map is obtained by integrating the Hamilton-Jacobi equation as an initial-value problem on a finite time interval. Given the generating function, the map is put in explicit form by means of a Fourier inversion technique. We give an example which suggests that the method has promise. 9 refs., 9 figs.

40852 **(SLAC-PUB—4645) Bunch lengthening in the SLC damping ring.** Rivkin, L.; Bane, K.; Chen, P.; Gabella, W.; Higo, T.; Hofmann, A.; Linebarger, W.; Kheifets, S.; Knight, T.; Morton, P. (Stanford Linear Accelerator Center, Menlo Park, CA (USA)). May 1988. Contract AC03-76SF00515. 3p. (CONF-880695—15). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88012740/JAW.

From 1. European particle accelerator conference; Rome, Italy (7 Jun 1988).

In this paper we present the results of measurements of bunch length and bunch shape as a function of current in the SLC e/sup {minus}/damping ring. After extraction, the SLC bunch is compressed by means of an RF compressor and a subsequent high dispersion section. By inserting a video screen at a point of large dispersion and by using the correlation between bunch length and energy spread induced by the compressor, we have measured not only the bunch length but also the longitudinal charge distribution of the bunch in the damping ring as a function of beam intensity. At 3 {times} 10^{10} particles per bunch with a peak ring RF voltage of 800 KV, the FWHM of the bunch length in the ring doubles over the nominal value. To measure the energy spread of the bunch in the damping ring, the optics of the extraction lines was modified to produce a large dispersion but small horizontal β function at the video screen. At 3 {times} 10^{10} particles per bunch, the relative energy spread in the rings is increased by about 30%. Finally, these data are compared with calculations of bunch lengthening in the SLC damping rings. 8 refs., 6 figs.,

40853 **(SLAC-PUB—4656) Physics with polarized electron beams.** Swartz, M.L. (Stanford Linear Accelerator Center, Menlo Park, CA (USA)). Jun 1988. Contract AC03-76SF00515. 48p. (CONF-870821—13). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88012745/JAW.

From SLAC summer institute on particle physics: looking beyond the Z; Stanford, CA, USA (10 Aug 1987).

As a distinct field, elementary particle physics is now approximately forty years old. In all that time, only a few of the thousands of experiments that have been performed have made use of spin polarized particle beams. There are two reasons for this lack of interest. The first is that spin polarized beams are difficult to produce, accelerate, and transport. The second reason is that any physical process that can occur during the collision of a polarized particle with another (polarized or not) can also occur during the collision of unpolarized particles. One might ask then, why has any effort been expended on the subject? The answer, at least in the case of polarized electron beams, is that electron accelerators and storage rings have in recent years achieved sufficient energy to begin to probe the weak interaction directly. The weak interaction distinguishes between left- and right-handed fermionic currents. Left-handed particles interact in a fundamentally different way than their right-handed counterparts. If the experimenter wishes to explore or exploit this difference, he (or she) must either prepare the spin state of the incident particles or analyze the spin state of outgoing particles. For reasons, of generality and improved statistical precision, the former is usually preferable to the latter. The first of these lectures will review some of the techniques necessary for the production, transport, and monitoring of polarized electron (or positron) beams. The second lecture will survey some of the physics possibilities of polarized electron--positron collisions. 33 refs., 26 figs., 5 tabs.

40854 **(UCID—21330) DART: a simulation code for charged particle beams.** White, R.C.; Barr, W.L.; Moir, R.W. (Lawrence Livermore National Lab., CA (USA)). 16 May 1988. Contract W-7405-ENG-48. 40p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88011757/JAW.

This paper presents a recently modified verion of the 2-D DART code designed to simulate the behavior of a beam of charged particles whose paths are affected by electric and magnetic fields. This code was originally used to design laboratory-scale and full-scale beam direct converters. Since then, its utility has been expanded to allow more general applications. The simulation technique includes space charge, secondary electron effects, and neutral gas ionization. Calculations of electrode placement and energy conversion efficiency are described. Basic operation procedures are given including sample input files and output. 7 refs., 18 figs.

40855 **Non-uniform attenuation and scatter correction in spect.** Singh, M.; Horne, M.; Maneval, D.; Amartey, J.; Brechner, R. (Dept. of Radiology and Biomedical Engineering, Univ. of Southern California, PSC-610, 1985 Zonal Avenue, Los Angeles, CA (US)). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* 35: No. 1, 767-771(Feb 1988). (CONF-871006—).

From 34. nuclear science symposium and 19. nuclear power systems symposium; San Francisco, CA, USA (21 Oct 1987).

Using a large test-object containing an asymmetrical distribution of Tc-99m activity and non-uniform attenuation, techniques have been developed and evaluated to correct for attenuation and scatter in the object in conjunction with a filtered backprojection reconstruction algorithm. A weighted backprojection approach where corrections are applied to each pixel from each angle of view was used to correct the attenuation. Using a germanium detector to sample the energy spectrum of emitted radiation, an optimal method was devised to subtract scatter counts from the photopeak counter of a scintillation camera before reconstruction. SPECT images of the test-object were evaluated to validate the correction approaches.

40856 **A positron tomograph with 600 BGO crystals and 2.6 mm resolution.** Derenzo, S.E.; Huesman, R.H.; Cahoon, J.L.; Geyer, A.B.; Moses, W.W.; Uber, D.C.; Vuletich, T.; Budinger, T.F. (Donner Lab. and Lawrence Berkeley Lab., Univ. of California, Berkeley, CA (US)). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* 35: No. 1, 659-664(Feb 1988). (CONF-871006—).

From 34. nuclear science symposium and 19. nuclear power systems symposium; San Francisco, CA, USA (21 Oct 1987).

The authors describe the imaging performance of the Donner 600-Crystal Positron Tomograph, a single 60 cm diam ring of 3 mm wide bismuth germanate (BGO) crystals coupled individually to 14 mm phototubes. With a pulse height threshold of 200 keV and a slice thickness of 5 mm, the sensitivity is 7024 events/sec per μCi/ml in a 20 cm cylinder of water. The measured rates for 18 μCi/ml are 95,000 trues/sec plus 20,000 random/sec. A 0.3 mm diam /sup 22/Na line source near the center of the tomograph has a circular point spread function (PSF) with a full-width at half-maximum (fwhm) of 2.6 mm. At 5 cm from the center the PSF is elliptical with a fwhm of 2.7 mm tangential x 3.2 mm radial. At 10 cm the PSF has a fwhm of 2.8 mm tangential x 4.8 mm radial. Attenuation data are accumulated with a 20 mCi /sup 68/Ge orbiting transmission source and 100 million coincident events are collected in 200 sec.

40857 **New high-dispersion beamlines at the Bevalac for the production, purification and transport of radioactive beams.** Krebs, G.F.; Alonso, J.R.; Kalnins, J.; Matsuta, K.; Minamisono, T.; Nojiri, Y.; Sugimoto, K.; Takeyama, K.; Omata, K.; Shida, Y. (Lawrence Berkeley Lab., Univ. of California, Berkeley, CA (US)). pp 848-850 of Proceedings of the 1987 IEEE particle accelerator conference: Accelerator engineering and technology. Lindstrom, E.R.; Taylor, L.S. Piscataway, NJ; IEEE Service Center (1987). (CONF-870302—). Contract AC03-76SF00098.

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

The external particle beam transport area of the Lawrence Berkeley Laboratories Bevalac was redesigned so that radioactive beams may be more efficiently analyzed and transported. Using a variety of relativistic heavy ions available at the Bevalac, radioactive beams can be formed at the first external focal point of the accelerator by the well known process of nuclear fragmentation. The large cross-section and small deflection of the projectile fragments leads to high production and delivery efficiency for these beams. Previously, at the Bevalac light radioactive ions of He, Li, Be, B, C have been delivered to an experimental area. Routinely ^{19}Ne is delivered to the biomedical treatment site. This paper reports on the production, purification and delivery of radioactive beams of /sup 20,21/F and ^{39}Ca.

40858 **Beam transfer from the core of the accumulator to the main ring in the Fermilab source.** Bharadwaj, V.K.; Griffin, J.E.; Harding, D.J.; MacLachlan, J.A. (Fermi National Accelerator Lab., P.O. Box 500, Batavia, IL (US)). pp 1022-1024 of Proceedings of the 1987 IEEE particle accelerator conference: Accelerator engineering and technology. Lindstrom, E.R.; Taylor, L.S. Piscataway, NJ; IEEE Service Center (1987). (CONF-870302—).

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

This paper describes the transfer of a batch of antiproton bunches from the pbar stack in the Accumulator Ring to the Main Ring at Fermilab. These pbars are subsequently accelerated and used for pbar-p colliding beam physics in the Tevatron Ring.

40859 **Bunch coalescing in the Fermilab Main Ring.** Wildman, D.; Martin, P.; Meisner, K.; Miller, H.W. (Fermi National Accelerator Lab., P.O. Box 500, Batavia, IL (US)). pp 1028-1030 of Proceedings of the 1987 IEEE particle accelerator conference: Accelerator engineering and technology. Lindstrom, E.R.; Taylor, L.S. Piscataway, NJ; IEEE Service Center (1987). (CONF-870302—).

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

A new RF system has been installed in the Fermilab Main Ring to coalesce up to 13 individual bunches of protons or antiprotons into a single high-intensity bunch. The coalescing process consists of adiabatically reducing the h=1113 Main Ring RF voltage from 1 MV to less than 1 kV, capturing the debunched beam in a linearized h=53 and h=106 bucket, rotating for a quarter of a synchrotron oscillation period, and then recapturing the beam in a single h=1113 bucket. The new system is described and the results of recent coalescing experiments are compared with computer-generated particle tracking simulations.

40860 **Correction of persistent current effects on dynamic behavior of SSC lattices.** Leemann, B.T. (SSC Central Design Group, Lawrence Berkeley Lab., Berkeley, CA (US)). pp 1031-1033 of Proceedings of the 1987 IEEE particle accelerator conference: Accelerator engineering and technology. Lindstrom, E.R.; Taylor, L.S. Piscataway, NJ; IEEE Service Center (1987). (CONF-870302—).

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

The persistent current effects on the dynamic properties of a standard SSC test lattice with clustered IRs are shown for superconductor filaments of various diameters. Three different correction schemes are compared. The most complete compensation is achieved by locally correcting the b_2 and b_4 multipole components with two layers of bore tube corrector windings. Lumped correction by two independent two-family sextupole and decapole correctors proves insufficient. A nearly local correction scheme with the different corrector windings extending only over a fraction of the magnet length but arranged in a single layer is found to be an excellent compromise.

40861 **Effect of the space-charge force on tracking at low energy.** Furman, M.A. (SSC Central Design Group, c/o Lawrence Berkeley Lab., Berkeley, CA (US)). pp 1034-1036 of Proceedings of the 1987 IEEE particle accelerator conference: Accelerator engineering and technology. Lindstrom, E.R.; Taylor, L.S. Piscataway, NJ; IEEE Service Center (1987). (CONF-870302—).

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

The authors present tracking results for the SSC's Low Energy Booster at injection energy, including the effect of the space-charge force. The bunches are assumed to be gaussian with elliptical cross-section. Magnet errors and sextupoles are not included, but an RF cavity is. The authors compare the phase space with and without synchrotron oscillations, with and without space-charge. The effective emittance is not significantly altered. They also present results on tune shifts with amplitude.

40862 **Electron-beam propagation in a reduced-density channel.** Czuchlewski, S.J.; Kauppila, T.J.; Stout, L.E.; Mitrovich, D. (Los Alamos National Lab., P.O. Box 1663, Los Alamos, NM (US)). pp 1040-1042 of Proceedings of the 1987 IEEE particle accelerator conference: Accelerator engineering and technology. Lindstrom, E.R.; Taylor, L.S. Piscataway, NJ; IEEE Service Center (1987). (CONF-870302—). Contract W-7405-ENG-36.

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

An experiment is underway to study the atmospheric propagation of the 27-MeV PHERMEX electron beam in a reduced-density channel generated by a CO_2 laser.

40863 **Emittance growth in intense mismatched beams.** Anderson, O.A.; Soroka, L. (Lawrence Berkeley Lab., Univ. of California, Berkeley, CA (US)). pp 1043-1045 of Proceedings of the 1987 IEEE particle accelerator conference: Accelerator engineering and technology. Lindstrom, E.R.; Taylor, L.S. Piscataway, NJ; IEEE Service Center (1987). (CONF-870302—). Contract AC03-76SF00098.

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

The authors use analysis and numerical simulation to study transverse rms emittance growth in a space-charge dominated beam, mismatched to its transport channel. They discuss two cases: (I) a uniform cold beam injected into a slightly nonlinear channel, and (II) a semi-Gaussian beam injected into a linear channel. Nonlinear coupling damps the mismatch oscillations, converting the mismatch electrostatic energy into emittance growth. In case I, analysis shows a slow growth rate proportional to the channel nonlinearity parameter and predicts nearly complete damping and conversion to emittance growth, their simulations confirm these predictions. In case II the simulations show that damping is arrested and conversion is incomplete. Sequences of density profiles clarify this effect. The phase of the profile oscillations changes, after a few plasma periods, in a way that inhibits the rms emittance growth. The growth is entirely due to a halo that includes only a small fraction of the beam, unlike the situation in case I. In general, there is little practical difference between phenomena in sheet beams and round beams, but the analysis is usually much simpler in the former case. Therefore, in the present report the authors restrict themselves to sheet beams. The authors use the standard beam model and again simplify their equations by omitting relativistic factors.

40864 **Experimental measurement of emittance growth in mismatched space-charge-dominated beams.** Tiefenback, M.G. (Lawrence Berkeley Lab., Univ. of California, Berkeley, CA (US)). pp 1046-1048 of Proceedings of the 1987 IEEE particle accelerator conference: Accelerator engineering and technology. Lindstrom, E.R.; Taylor, L.S. Piscataway, NJ; IEEE Service Center (1987). (CONF-870302—). Contract AC03-76SF00098.

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

Using the Single Beam Transport Experiment (SBTE) at LBL, the authors measured the emittance of a well-matched 4.6-mA beam of 122-keV Cs^+ to be conserved from injection into through exit from an 80-lens segment of the AG focussing channel. They then mismatched the beam into the same channel such that the maximum (minimum) radius of the beam at the midplane between lenses was about 1.5 (0.5) times the former value. The author caused mismatches in the envelope of the beam in both transverse dimension (labeled a and b) in modes both symmetric ($\delta a = \delta b$) and antisymmetric ($\delta a = -\delta b$). The authors found the mismatch amplitude to decay during the beam transit through the channel for both modes of mismatch, although more so for the antisymmetric mode. They also found the emittance of the symmetrically mismatched beam to be the same as for the matched beam, while the emittance of the antisymmetrically mismatched beam grew by as much as a factor of four over that for the matched beam.

40865 **Energy loss of bunched beams in SSC RF cavities.** Furman, M.; Lee, H.; Zotter, B. (SSC Central Design Group, c/o Lawrence Berkeley Lab., Berkeley, CA (US)). pp 1049-1050 of Proceedings of the 1987 IEEE particle accelerator conference: Accelerator engineering and technology. Lindstrom, E.R.; Taylor, L.S. Piscataway, NJ; IEEE Service Center (1987). (CONF-870302—).

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

A bunched beam that is accelerated by the fundamental resonant mode of RF cavities necessarily loses energy by exciting the higher-order modes of these very cavities. The authors consider here the calculation of the power lost by gaussian bunches traversing a structure with resonator impedance of arbitrary quality factor. Known formulas are used for the infinite summations, which reduce to other approximate ones for the broad-band case. For the narrow-band case they present a simple analytic expression. They apply the results to calculate the power lost to the higher-order modes of the SSC RF cavities. The authors' conclusion is that if the resonant frequencies of all higher-order modes of the cavities are sufficiently far from integral multiples of the bunch frequency, the energy loss is strongly reduced over that calculated by a simple broad-band model; but if this condition is not satisfied, then the resulting resonant loss for even a weak mode may be several orders of magnitude greater than the broad-band calculation.

40866 **Impedances of bellows corrugations.** Ng, K.Y. (Fermi National Accelerator Lab., Batavia, IL (US)). pp 1051-1053 of Proceedings of the 1987 IEEE particle accelerator conference: Accelerator engineering and technology. Lindstrom, E.R.; Taylor, L.S. Piscataway, NJ; IEEE Service Center (1987). (CONF-870302—).

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

The longitudinal and transverse coupling impedances of inner bellows can be derived by running TBCI and taking Fourier transforms. However, the eventual impedance plots are only very approximate because the result are usually marred by errors due to the finite mesh size and the truncation of the wake potentials. It has been reported that TBCI gives results in conflict with other codes like KN7C and TRANSVRS. Also, a long wake for a simple pillbox cavity even diverges in the dipole mode. In this paper, the authors want to present a physical understanding of the impedance plots and try to gather some formulae so that the main features of the impedances can be approximately derived without the actual running of any time-consuming codes.

40867 **AB initio calculation of nonlinear transient beam dynamics for ion linacs and injectors.** Whealton, J.H.; Raridon, R.J.; Bell, M.A.; Rothe, K.E.; Murphy, B.D.; Ryan, P.M. (Oak Ridge National Lab., Oak Ridge, TN (US)). pp 1057-1059 of Proceedings of the 1987 IEEE particle accelerator conference: Accelerator engineering and technology. Lindstrom, E.R.; Taylor, L.S. Piscataway, NJ; IEEE Service Center (1987). (CONF-870302—).

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

Details of a fully three-dimensional transient, time-dependent Vlasov-Poisson analysis are presented, including treatment of space charge, boundaries, convergence, nonlinearities, plasma, accuracy, economy, validity, and limitations. The potential applications to an RFQ at high beam current are indicated with particular emphasis on beam halo, apparent emittance growth, and instabilities caused by beam space charge and aberrations. A single space-charge kick numerical runaway phenomenon is described which is important for intense ion beams. The analysis embodies all orders of nonlinearities, all orders of nonrelativistic image charges, and accuracies on the order of 10^{-8} rad in the in velocity distribution function. Evolution in the analysis has led to resource economy improvement of $\sim 10^9$ while simultaneously increasing accuracy by as much a 10^6. Such improvements permit the consideration of complicated problems.

40863 **Electron controlled transport of intense neutralized ion beams.** Burkhart, C.; Humphries, S. Jr. (Institute for Accelerator and Plasma Beam Technology, Univ. of New Mexico, Albuquerque, NM (US)). pp 1037-1039 of Proceedings of the 1987 IEEE particle accelerator conference: Accelerator engineering and technology. Lindstrom, E.R.; Taylor, L.S. Piscataway, NJ; IEEE Service Center (1987). (CONF-870302—).

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

Experimental results are reported for an extended transport channel for long pulse, intense, neutralized ion beams. The transport channel is defined by neutralizing electrons confined by a weak solenoidal magnetic field (ion transit time $<< 2\pi\omega/$sub ci/). Charge separation sheaths which occur when ions expand beyond the confined electron channel reflect the ions. Electrons which diffuse out of the transport region are removed by electrostatic fields. A 10 μs, 28 keV, .17 A beam of singly charged carbon ions is used to investigate the properties of the transport channel. With modest magnetic fields (< 100 G), the ion current incident on a collector .75 m from the ion source is increased a factor of 2.5 over vacuum transport levels. The addition of a small transverse magnetic field, ≦ 5 G, decreases the transported ion current. The reduction in current is consistent with the magnetic transport channel model. The scaling of transported ion current with magnetic field strength and sweeping bias is examined. Transport systems of this type may have direct application to both the low velocity initial stages and the high current final focussing region of accelerator inertial fusion drivers.

40869 **Minimum beam-energy spread of a high-current rf linac.** Chan, K.C.D.; Fraser, J.S. (Los Alamos National Lab., Los Alamos, NM (US)). pp 1075-1077 of Proceedings of the 1987 IEEE particle accelerator conference: Accelerator engineering and technology. Lindstrom, E.R.; Taylor, L.S. Piscataway, NJ; IEEE Service Center (1987). (CONF-870302—).

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Energy spread is an important parameter of an electron linac and, usually, is determined by the time dependence of the external rf accelerating field. By using a combination of fundamental and higher harmonic frequencies, the accelerating field can be maintained approximately constant over a beam bunch with the resultant energy spread approximately zero. This technique is no longer adequate when the longitudinal wake field of the beam bunch is taken into account. The wake-field variation along the bunch length introduces an energy spread that cannot be exactly compensated for with the use of fundamental and higher harmonic frequencies. The achievable minimum energy spread including the wake-field effect is therefore limited. In this paper, the authors report the minimum energy spreads achievable using the fundamental and third-harmonic frequencies, calculated using a least-squares algorithm, for some typical structures in use at Los Alamos National Laboratory. The dependence of these results on bunch shape, bunch charge, and structure frequency is discussed. Also included are discussions of schemes for implementing the third-harmonic frequency and their effectiveness.

40870 **Multipass beam breakup in recirculating linacs.** Bisognano, J.J.; Gluckstern, R.L. (CEBAF, 12070 Jefferson Ave., Newport News, VA (US)). pp 1078-1080 of Proceedings of the 1987 IEEE particle accelerator conference: Accelerator engineering and technology. Lindstrom, E.R.; Taylor, L.S. Piscataway, NJ; IEEE Service Center (1987). (CONF-870302—).

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Multipass beam breakup, a transverse beam instability generated by coherent excitation of cavity higher order modes in a recirculating linac, is a particular concern in designs utilizing superconducting technology. In this paper an analytic model is presented that includes a description of this effect for a distribution of cavities along the linac with several recirculations in an impulse approximation. For N passes and M cavities, solution of the resulting equations reduces in general to finding M zeros of a 2(n-1) dimensional determinant or equivalently the M eigenvalues of an M-dimensional matrix. The parametric dependence of this system on higher order mode frequencies and Q, lattice functions, and transit times is discussed. Numerical examples are presented to clarify these issues and to model the CEBAF superconducting linac, where threshold currents are found to exceed design currents by more than an order of magnitude.

40871 **Particle tracking in E-phi space as a design tool for cyclic accelerators.** MacLachlan, J.A. (Fermi National Accelerator Lab., P.O. Box 500, Batavia, IL (US)). pp 1087-1089 of Proceedings of the 1987 IEEE particle accelerator conference: Accelerator engineering and technology. Lindstrom, E.R.; Taylor, L.S. Piscataway, NJ; IEEE Service Center (1987). (CONF-870302—).

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

To help specify some unconventional rf systems for the Tevatron I project and assist in optimizing a Y/sub t/ jump transition crossing for the Booster at Fermilab, a particle tracking program (ESME) has been developed which has been useful in several design applications. Its purpose is to calculate the evolution of distributions in longitudinal phase space with sufficient completeness to represent accurately the behavior of real systems. It is widely applicable because it is organized around a core of basic facilities in a manner designed to simplify the inclusion of application-specific code and refinements like beam feedback, wall impedance, et al. The basis and representative features of the program are described.

40872 **Experimental laboratory for study of nonlinear quantum/classical dynamics in an R.F. bucket.** Kells, W. (Fermi National Accelerator Lab. (US)). pp 1099-1101 of Proceedings of the 1987 IEEE particle accelerator conference: Accelerator engineering and technology. Lindstrom, E.R.; Taylor, L.S. Piscataway, NJ; IEEE Service Center (1987). (CONF-870302—).

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

Several advantages of using single Penning trapped particles (electron or proton) for long term dynamical studies of chaos are described. Such studies would complement, for instance, several recent speculations on the transition from quantum like to classical like motion of such systems. Since the Penning rap dynamics are formally equivalent to familiar accelerator (synchrocylotron) longitudinal motion these studies would be relevant to understanding aspects of machine stability

40873 **Global beta measurement from two perturbed closed orbits.** Harrison, M.; Peggs, S. (Fermilab, Batavia, IL (US)). pp 1105-1107 of Proceedings of the 1987 IEEE particle accelerator conference: Accelerator engineering and technology. Lindstrom, E.R.; Taylor, L.S. Piscataway, NJ; IEEE Service Center (1987). (CONF-870302—).

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

A simple algorithm is presented which transforms two closed orbits observed at beam position monitors around a ring into B and phi values at the monitors. The procedure assumes the prior use of a second algorithm to measure B/sub c/ and phi/sub c/ at the two dipole correctors used to excite the perturbed closed orbits. Test results from the program BETA, written to measure β around the Tevatron, are shown. The sensitivities of the measurement to monitor digitisation and to quadrupole errors between the reference correctors are estimated.

40874 **Simulation of a programmed frequency shift near extraction from the Fermilab Booster.** Lucas, P.; Kerns, Q. (Fermi National Accelerator Lab., P.O. Box 500, Batavia, IL (US)). pp 1108-1110 of Proceedings of the 1987 IEEE particle accelerator conference: Accelerator engineering and technology. Lindstrom, E.R.; Taylor, L.S. Piscataway, NJ; IEEE Service Center (1987). (CONF-870302—).

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

The longitudinal phase space program ESME has been used to simulate the effects of a linear shift in RF frequency away from that appropriate for the accelerator guide field. This shift takes

place in the new Booster low level RF and is used to position the particle bunches in Main Ring buckets in a reproducible fashion. Shifts in frequency are found to generate synchrotron oscillations; however the simulations show that these can be reduced to acceptable levels by introduction of jumps in RF phase preceding the programmed frequency changes. Lowering the RF voltage near extraction from the Booster, a desirable operational feature, has also been investigated.

40875 **Simulation of beam loss in the Los Alamos Proton Storage Ring.** Mottershead, C.T.; Lawrence, G.P.; Channell, P.J.; Schweitzer, L.B. (Los Alamos National Lab., Los Alamos, NM (US)). pp 1111-1113 of Proceedings of the 1987 IEEE particle accelerator conference: Accelerator engineering and technology. Lindstrom, E.R.; Taylor, L.S. Piscataway, NJ; IEEE Service Center (1987). (CONF-870302—).

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The Los Alamos Proton Storage Ring experiences a significant beam loss as a consequence of scattering in the stripper foil. This paper reviews efforts to understand this loss by computer simulation using the Lie algebraic tracking code MARYLIE, and other special codes that give a very fast simulation of the foil scattering. Simulation results are compared to experimental data.

40876 **Simulation of space charge effects and transition crossing in the Fermilab Booster.** Lucas, P.; MacLachlan, J. (Fermi National Accelerator Lab., P.O. Box 500, Batavia, IL (US)). pp 1114-1116 of Proceedings of the 1987 IEEE particle accelerator conference: Accelerator engineering and technology. Lindstrom, E.R.; Taylor, L.S. Piscataway, NJ; IEEE Service Center (1987). (CONF-870302—).

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

The longitudinal phase space program ESME, modified for space charge and wall impedance effects, has been used to simulate transition crossing in the Fermilab Booster. The simulations yield results in reasonable quantitative agreement with measured parameters. They further indicate that a transition jump scheme currently under construction will significantly reduce emittance growth, while attempts to alter machine impedance are less obviously beneficial. In addition to presenting results, this paper points out a serious difficulty, related to statistical fluctuations, in the space charge calculation. False indications of emittance growth can appear if care is not taken to minimize this problem.

40877 **Simulation studies of emittance growth from image-charge and focusing-field nonlinearities in a periodic solenoidal channel.** Rudd, H.; Haber, I.; Reiser, M. (Berkeley Scholars, Inc., Springfield, VA (US)). pp 1120-1122 of Proceedings of the 1987 IEEE particle accelerator conference: Accelerator engineering and technology. Lindstrom, E.R.; Taylor, L.S. Piscataway, NJ; IEEE Service Center (1987). (CONF-870302—).

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

A series of particle-in-cell computer simulations is used to examine the self-consistent nonlinear behavior of an intense charged particle beam in a periodic solenoidal transport system. The detailed parameters of the transport system, such as the model for the focusing-magnet fields, as well as the location of the bounding conducting pipe, have been chosen to facilitate a direct comparison to experimental results obtained from the University of Maryland intense beam transport experiment.

40878 **Space charge effects in a bending magnet system.** Lee, E.P.; Close, E.; Smith, L. (Lawrence Berkeley Lab., Univ. of California, Berkeley, CA (US)). pp 1126-1128 of Proceedings of the 1987 IEEE particle accelerator conference: Accelerator engineering and technology. Lindstrom, E.R.; Taylor, L.S. Piscataway, NJ; IEEE Service Center (1987). (CONF-870302—).

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

In order to examine problems and phenomena associated with space charge in a beam bending system, the beam dynamics code HICURB has been written. Its principal features include momentum variations, vertical and horizontal envelope dynamics coupled to the off-axis centroid, curvature effect on fields, and images. Preliminary results for an achromatic lattice configuration are presented.

40879 **Space-charge effects of transition crossing in the Fermilab booster.** Ng, K.Y. (Fermi National Accelerator Lab., Batavia, IL (US)). pp 1129-1131 of Proceedings of the 1987 IEEE particle accelerator conference: Accelerator engineering and technology. Lindstrom, E.R.; Taylor, L.S. Piscataway, NJ; IEEE Service Center (1987). (CONF-870302—).

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

The area of a typical Fermilab booster bunch is roughly constant before transition but increases abruptly afterward. The mountain-range plots reveal quadrupole bunch oscillations after transition. This increase in bunch area may not be a result of microwave growth but is due to the mismatch of the RF bucket introduced by space-charge effects. The space-charge force increases the energy of particles at the front of a bunch and decreases it at the rear. Thus, below transition, the bunch is longer than if space-charge were absent and is shorter above transition. After transition the bunch length will have to be shortened in order to fit the bucket. But, in doing so, it will generally overshoot (become too short) and therefore oscillate about the equilibrium length.

40880 **Stacktail momentum cooling in the Fermilab Anti-proton source.** Pasquinelli, R.J.; Hyslop, W.; Kells, W.; Kuchnir, M.; Marriner, J.; Mayer, G.; McCarthy, J.; Mtingwa, S.; Peterson, D.; Shafer, R. (Fermi National Accelerator Lab., P.O. Box 500, Batavia, IL (US)). pp 1132-1134 of Proceedings of the 1987 IEEE particle accelerator conference: Accelerator engineering and technology. Lindstrom, E.R.; Taylor, L.S. Piscataway, NJ; IEEE Service Center (1987). (CONF-870302—).

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The stacktail momentum cooling system is one of eight cooling systems in the Fermilab Anti-proton source. The use of cryogenic pickups, preamps, and superconducting notch filters make it the most complex in terms of hardware and operation. This paper describes some of the hardware and its operation along with the latest performance results of the present pbar running period.

40881 **The effect of errors in charged particle beams.** Carey, D.C. (Fermi National Accelerator Lab., Batavia, IL (US)). pp 1146-1148 of Proceedings of the 1987 IEEE particle accelerator conference: Accelerator engineering and technology. Lindstrom, E.R.; Taylor, L.S. Piscataway, NJ; IEEE Service Center (1987). (CONF-870302—).

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Residual errors in a charged particle optical system determine how well the performance of the system conforms to the theory on which it is based. Mathematically possible optical modes can sometimes be eliminated as requiring precisions not attainable. Other plans may require introduction of means of correction for the occurrence of various errors. Error types include misalignments, magnet fabrication precision limitations, and magnet current regulation errors. A thorough analysis of a beam optical system requires computer simulation of all these effects. A unified scheme for the simulation of errors and their correction is discussed.

40882 **The influence of density distribution on the stability of beams.** Guy, F.W.; Lapostolle, P.M.; Wangler, T.P. (Los Alamos National Lab., Los Alamos, NM (US)). pp 1149-1151 of Proceedings of the 1987 IEEE particle accelerator conference: Accelerator engineering and technology. Lindstrom, E.R.; Taylor, L.S. Piscataway, NJ; IEEE Service Center (1987). (CONF-870302—).

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The authors examine the effect of various density distributions in four-dimensional phase space and their projections in real

and velocity space on the stability of continuous beams in alternating-gradient transport lines using particle-following computer simulations. They discuss the susceptibility of three different distributions (Kapchinskii-Vladimirskii, bicylinder, and thermal) to third- and higher-order mode instabilities. These distributions are all uniform in real space, but their velocity distributions are different; they also react differently to structure resonances. Velocity distributions of high-current beams tend to evolve to a peaked Gaussian-like form. Is there a specific velocity distribution that is stable and, therefore, the preferred injection distribution for minimizing emittance growth? Forced smoothness or uniformity in real space is necessary for setting up particle simulations of high-current beams so that spurios charge-redistribution emittance growth can be avoided. Is forced smoothness also desirable in four dimensions for continuous beams and possibly in six dimensions for bunched beams? The authors consider these and related questions.

40883 **Three-dimensional corrections to the longitudinal dynamics of a long beam in a periodically focused transport system.** Haber, I. (Naval Research Lab., Washington, DC (US)). pp 1158-1160 of Proceedings of the 1987 IEEE particle accelerator conference: Accelerator engineering and technology. Lindstrom, E.R.; Taylor, L.S. Piscataway, NJ; IEEE Service Center (1987). (CONF-870302—).

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

A series of "quasi three-dimensional" computer simulations is presented which examines the consequences of the transverse variation of the longitudinal self-electric-field on the dynamics of a coasting beam whose current is assumed to vary slowly over a distance long compared with the transverse dimensions of the beam system. In this approximation, the local longitudinal field is proportional to the product of the derivative of the line charge density and the local electrostatic potential. The longitudinal dynamics are examined by integrating the orbits of an ensemble of simulation particles in their transverse fields, and using the self-consistent potential generated during the simulation, along with an assumed value for the derivative of line charge density, to calculate the detailed longitudinal fields for integration of the longitudinal orbits

40884 **Transverse combining of nonrelativistic beams in a multiple beam induction linac.** Celata, C.M.; Faltens, A.; Judd, D.L.; Smith, L.; Tiefenback, M.G. (Lawrence Berkeley Lab., Univ. of California, Berkeley, CA (US)). pp 1167-1169 of Proceedings of the 1987 IEEE particle accelerator conference: Accelerator engineering and technology. Lindstrom, E.R.; Taylor, L.S. Piscataway, NJ; IEEE Service Center (1987). (CONF-870302—). Contract AC03-76SF00098.

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

Emittance growth of beams during transverse combining has been studied computationally and experimentally for Heavy Ion Fusion applications, and the theory and results are presented. A hardware design is also discussed.

40885 **Beam aperture and emittance growth in the AGS-Booster.** Parsa, Z. (Accelerator Development Dept., Brookhaven National Lab., Upton, NY (US)). pp 1170-1172 of Proceedings of the 1987 IEEE particle accelerator conference: Accelerator engineering and technology. Lindstrom, E.R.; Taylor, L.S. Piscataway, NJ; IEEE Service Center (1987). (CONF-870302—).

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

The authors have developed analytical tools for calculating the variation of particle action, smear and emittance growth due to nonlinear elements in accelerators (with second order perturbation theory in two dimensions). The authors' results for the AGS-Booster is presented.

40886 **Chromatic perturbation and resonance analysis for the AGS-Booster.** Parsa, Z. (Accelerator Development Dept., Brookhaven National Lab., Upton, NY (US)). pp 1173-1175 of Proceedings of the 1987 IEEE particle accelerator conference: Accelerator engineering and technology. Lindstrom, E.R.; Taylor, L.S. Piscataway, NJ; IEEE Service Center (1987). (CONF-870302—).

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

The authors investigated the nonlinear effects with the emphasis on nonlinear resonances. They present some of their findings, (e.g. the structure resonances; stop-bandwidths, etc.) for the AGS-Booster Lattice using program HARMON. Comparison with the results obtained from the algorithm "NONLIN" is presented.

40887 **Space charge limits in the AGS booster.** Parzen, G. (Accelerator Development Dept., Brookhaven National Lab., Upton, NY (US)). pp 1182-1184 of Proceedings of the 1987 IEEE particle accelerator conference: Accelerator engineering and technology. Lindstrom, E.R.; Taylor, L.S. Piscataway, NJ; IEEE Service Center (1987). (CONF-870302—).

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

Space charge effects are expected to be strong in the AGS booster. The beam intensity may be high enough to cause upsilon-shifts due to space charge of the order of Δupsilon ≃ .5. In this paper, space charge effects are studied through the use of a tracking program. At each element of the lattice the particles receive a kick which is proportional to the electric field E/sub x/, E/sub y/ produced by the beam and to the length of the element. The beam growth can be studied using the tracking program to track a sample of the particles and to use the growth found in the tracking to find the change in the beam shape and in the beam size. The techniques used and the assumptions made in studying beam growth are described in the following sections. Using the results found for the beam growth, one can find the space charge limit which is defined as the beam intensity that causes the beam to grow where it reaches the available aperture limits of the accelerator. Space charge limit results are found for the AGS Booster. For a beam of fixed dimensions, which is not growing, the tracking program allows one to compute various effects, some of which are difficult to compute by analytical means. One can compute the space charge upsilon-shift as a function of the particle momentum and as a function of the particle betatron oscillation amplitude. One can also study the effects due to resonances which are excited by magnetic field imperfections or by the field of the beam itself. This study would include the important effect due to the change in the upsilon-values because of changes in the betatron oscillation amplitude. The case of two dimensional motion could also be studied.

40888 **Second order perturbation in the AGS-Booster.** Parsa, Z. (Accelerator Development Dept., Brookhaven National Lab., Upton, NY (US)). pp 1179-1181 of Proceedings of the 1987 IEEE particle accelerator conference: Accelerator engineering and technology. Lindstrom, E.R.; Taylor, L.S. Piscataway, NJ; IEEE Service Center (1987). (CONF-870302—).

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

The authors developed an analytical method for examining the nonlinear effects in accelerators including the Hamiltonian resonance strengths, generating functions resonance strengths, fixed points, Chirikov Criteria, island width, perturbation of tune, emittance growth, etc. They incorporated some of their findings into an algorithm which they used to investigate the structure resonances in the SSC and the AGS-Booster.

40889 **Possible benefits from shuffling dipoles in the RHIC.** Ohnuma, S. (Univ. of Houston and the Texas Accelerator Center (US)). pp 1176-1178 of Proceedings of the 1987 IEEE particle accelerator conference: Accelerator engineering and technology. Lindstrom, E.R.; Taylor, L.S. Piscataway, NJ; IEEE Service Center (1987). (CONF-870302—).

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

RHIC is the Relativistic Heavy Iion Collider which is being studied at Brookhaven National Laboratory. Unlike the linear aperture of the Tevatron or the SSC for which the random sectupole component of dipoles is an important factor in limiting its value, the RHIC linear aperture is affected most by the random normal and skew quadrupole components since they introduce large errors in betatron amplitude functions and in dispersion functions. It will be shown that, with eight or twelve dipoles covering four or six regular cells sorted as a group, one can achieve an improvement of factor four to five over statistically expected values of quantities such as $\Delta\beta/\beta_x)/\text{rms}$ without introducing a large nonlinear distortion (sometimes called "smear") arising from the random sextupole component.

40890 **Spin with two snakes and overlapping resonances.** Lee, S.Y.; Zhao, X.F. (Accelerator Development Dept., Brookhaven National Lab., Upton, NY (US)). pp 1185-1187 of Proceedings of the 1987 IEEE particle accelerator conference: Accelerator engineering and technology. Lindstrom, E.R.; Taylor, L.S. Piscataway, NJ; IEEE Service Center (1987). (CONF-870302—).

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

The authors study the effect of multiple spin depolarization resonances on the spin of the particles with two snakes. They found that (1) When two resonances are well separated, the polarization can be restored in passing through these resonances provided that the snake resonances are avoided. (2) When two resonances are overlapping, the beam particles may be depolarized depending on the spacing between these two resonances. If the spacing between these two resonances is an odd number for two snakes, the beam particles may be depolarized depending on the strength of the resonance. When the spacing becomes an even number, the spin can tolerate a much larger resonance strength without depolarization. Numerical simulations can be shown to agree with the analytic formula. (3) However the spin is susceptible to the combination of an intrinsic and an imperfection resonances even in the present of the snakes. Numerical solutions indicates that the spin can be restored after the resonances provided that imperfection strength is less than 0.1 if intrinsic strength is fixed at 0.745.

40891 **Microwave instabilities in Booster and AGS.** Lee, S.Y.; Zhao, X.F. (Accelerator Development Dept., Brookhaven National Lab., Upton, NY (US)). pp 1188-1189 of Proceedings of the 1987 IEEE particle accelerator conference: Accelerator engineering and technology. Lindstrom, E.R.; Taylor, L.S. Piscataway, NJ; IEEE Service Center (1987). (CONF-870302—).

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Microwave instabilities is evaluated for the Booster and the AGS for the preparation of the relativistic heavy ion collider. The authors found that the Booster may require feedback system for the transverse instability at the high intensity proton operation. The coherent instability is not important for the nominal RHIC operational intensity.

40892 **Modification of acceleration element in TRANSPORT.** Hurd, J.W.; McGill, J. (Los Alamos National Lab., Los Alamos, NM (US)). pp 1198-1200 of Proceedings of the 1987 IEEE particle accelerator conference: Accelerator engineering and technology. Lindstrom, E.R.; Taylor, L.S. Piscataway, NJ; IEEE Service Center (1987). (CONF-870302—).

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

One of the uses at LAMPF of the beam-dynamics code TRANSPORT is to model and tune the proton beams in the side-coupled linac. Significant differences are found between measured beam characteristics and those calculated by an early version of TRANSPORT. These differences are reduced to acceptable limits by modification of the original transformation matrix used in the code. The modified element and a brief description of its derivation are presented. The modified matrix reduces to the original matrix in the relativistic limit. The modified matrix is also compared to results of numerical integration to obtain some indication of its accuracy.

40893 **Nonlinear behavior of the longitudinal modes of the coasting beam in a storage ring.** Bogacz, S.A.; Ng, R.Y. (Accelerator Theory Dept., Fermi National Accelerator Lab., P.O. Box 500, Batavia, IL (US)). pp 1201-1203 of Proceedings of the 1987 IEEE particle accelerator conference: Accelerator engineering and technology. Lindstrom, E.R.; Taylor, L.S. Piscataway, NJ; IEEE Service Center (1987). (CONF-870302—).

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A simple nonlinear model of a coasting beam coupled to a sharp storage ring-impedance is studied in the framework of the Vlasov equation. In the case of a Gaussian beam this non-perturbative formalism simplifies to a pair of equations of motion which together with the dispersion relation fully describe nonlinear saturation of initially unstable coherent mode. This, in turn, provides a stabilizing mechanism (via Landau damping) for the overall distribution function. Finally, some predictions about the energy overshoot are made.

40894 **Transverse beam break up in a periodic linac.** Decker, G.; Wang, J.M. (Brookhaven National Lab., Upton, NY (US)). pp 1210-1212 of Proceedings of the 1987 IEEE particle accelerator conference: Accelerator engineering and technology. Lindstrom, E.R.; Taylor, L.S. Piscataway, NJ; IEEE Service Center (1987). (CONF-870302—).

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

In this paper, the problem of cumulative beam break up in a periodic linac for a general impedance is discussed, with the effects of acceleration included. The transverse equations of motion for a set of identical point like bunches moving along the length of the linac are cast into a simple form using a smooth approximation. This results in a working formula that is used to analyze beam breakup. Explicit expressions for the transverse motion in the case of a single resonance impedance are found using saddle point integration. This is done first with no external focusing, and again in the strong focusing limit.

40895 **Space-charged-induced emittance growth in the transport of high-brightness electron beams.** Jones, M.E.; Carlsten, B.E. (Los Alamos National Lab., Los Alamos, NM (US)). pp 1319-1321 of Proceedings of the 1987 IEEE particle accelerator conference: Accelerator engineering and technology. Lindstrom, E.R.; Taylor, L.S. Piscataway, NJ; IEEE Service Center (1987). (CONF-870302—).

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The emittance induced by space charge in a drifting beam of finite length has been investigated, and a scaling law. The scaling law predicts the initial rate of emittance growth, before the beam shape has distorted significantly, and thus represents an upper bound on the rate of emittance increase. This scaling law has been substantiated by particle-in-cell simulation and the dependence on geometric factors evaluated for specific choices of the beam profile.

40896 **The chromatic correction in RHIC.** Lee, S.Y.; Dell, G.F.; Hahn, H.; Parzen, G. (Accelerator Development Dept., Brookhaven National Lab., Upton, NY (US)). pp 1328-1330 of Proceedings of the 1987 IEEE particle accelerator conference: Accelerator engineering and technology. Lindstrom, E.R.; Taylor, L.S. Piscataway, NJ; IEEE Service Center (1987). (CONF-870302—).

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The scheme for the correction of chromatic effects in the Relativistic Heavy Ion Collider at BNL is discussed. This scheme uses six families of sextupoles excited by four independent power supplies, and provides adequate control of linear and quadratic terms in the tune vs momentum dependence and reduces the variation of the betatron amplitude, vs momentum.

40897 **Tune space manipulations in jumping depolarizing resonances.** Ratner, L.G.; Ahrens, L.A. (AGS Dept., Brookhaven National Lab., Associated Universities, Inc., Upton, NY (US)). pp 1353-1355 of Proceedings of the 1987 IEEE particle accelerator conference: Accelerator engineering and technology. Lindstrom, E.R.; Taylor, L.S. Piscataway, NJ; IEEE Service Center (1987). (CONF-870302—).

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In February, 1986, the AGS polarized beam reached a momentum of 22 GeVc with a 45% polarization and an intensity of 1-2 x 10^{10} polarized protons per pulse at a repetition rate of 2.1 seconds. In order to achieve this, one had to overcome the effect of some 40 depolarizing resonances. In the first commissioning run in 1984, the authors reached 16.5 GeVc using, with suitable modifications, the conventional techniques first used at the Argonne ZGS. This worked well, but they found that the fast tune shifts required to cross the intrinsic depolarizing resonances were causing an increase in beam emittance which led to the need for stronger corrections later in the cycle and to diminished extraction efficiency. For the 1986 run, the authors were prepared to minimize this emittance growth by the application of slow quadrupole pulses to change the region in tune space in which they operated the fast tune quads. In this paper they give a brief description of the conventional corrections, but the main emphasis is on the descriptions of tune space manipulations.

40898 **Two dimensional simulations of multipass beam breakup.** Krafft, G.A.; Bisognano, J.J. (Continuous Electron Beam Accelerator Facility, 12070 Jefferson Avenue, Newport News, VA (US)). pp 1356-1358 of Proceedings of the 1987 IEEE particle accelerator conference: Accelerator engineering and technology. Lindstrom, E.R.; Taylor, L.S. Piscataway, NJ; IEEE Service Center (1987). (CONF-870302—).

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A vectorized two dimensional beam breakup code, TDBBU, is used to simulate bunch dynamics in recirculating accelerators. First, the code is briefly described, including effects needed to accurately model the CEBAF accelerator. Next, various code test are sketched. Finally, the multipass beam breakup threshold current is determined to be from 10-20 mA for the CEBAF accelerator, a result in agreement with other calculations of the threshold current.

40899 **Analysis of orbit perturbations of the SLC Arcs.** Weng, W.T.; Murray, J.; Chao, A. (Stanford Linear Accelerator Center, Stanford Univ., Stanford, CA (US)). pp 1361-1363 of Proceedings of the 1987 IEEE particle accelerator conference: Accelerator engineering and technology. Lindstrom, E.R.; Taylor, L.S. Piscataway, NJ; IEEE Service Center (1987). (CONF-870302—). Contract AC03-76SF00515.

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

The Stanford Linear Collider (SLC) is the first linear collider to be built. The repetition rate of a linear collider is much lower than that of a circular collider. To recover the luminosity, the emittance and beam size at collision point have to be one or two orders of magnitude smaller than a conventional collider. Therefore, for the SLC, the small beam emittance created from the damping ring has to be kept small by all possible means to preserve the luminosity potential for the physics experiment. To minimize emittance growth of electron and positron beams in the SLC Arcs, bending magnets with very strong quadrupole components have to be used. In addition, a sextupole component is included to eliminate the second order chromatic and geometric aberrations. Consequently, in the presence of magnet misalignments, both orbit error and optical distortion can be generated. This report concentrates on the generation and correction or orbit errors. The authors' analysis is applicable to any periodic lattice structure with periodic arrangement of beam monitors and correctors. The unique feature of SLC Arcs is that the orbit errors are corrected by moving magnets. The authors establish a general stability criterion for the orbit correction in Sec. 2. In Sec. 3, the rms orbit errors and corrector strengths are calculated. Finally, in Sec. 4, the formulation is applied to the design of SLC to obtain estimates for residual orbit distortion after correction.

40900 **Resonance topology.** Michelotti, L. (Fermilab, P.O. Box 500, Batavia, IL (US)). pp 1372 of Proceedings of the 1987 IEEE particle accelerator conference: Accelerator engineering and technology. Lindstrom, E.R.; Taylor, L.S. Piscataway, NJ; IEEE Service Center (1987). (CONF-870302—).

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

It is hard to find a satisfactory answer to the question, "What is a resonance?" To get a better feeling for the question and for what is required of an answer, consider the following thought experiment. Suppose that you are given a one-to-one symplectic mapping, F, defined over some four-dimensional phase space and realized in an unspecified system of coordinates. (Think of F, for example, as a tracking program that models the Poincare map of a 2 1/2 degree of freedom Hamiltonian system.) Starting from any number of points in phase space, you can calculate forward or backward iterates of F infinitely quickly. Further, you have unlimited capabilities for displaying these orbits on a four-dimensional graphics terminal. Given even these extraordinary tools, how would you test the simple hypothesis: "This system exhibits a first order sextupole resonance"? What topological features of the separatrix must be reflected in the "data" in order to confirm or deny such a statement? There is not enough space in a short paper like this to present a full analysis of this problem. The authors short-circuit the process and simply assert what is needed to define the separatrix of an integrably resonant dynamical system on a general 2p-dimensional phase space.

40901 **Space-charge distortion in the Brookhaven ionization profile monitor.** Thern, R.E. (AGS Dept., Brookhaven National Lab., Associated Universities, Inc., Upton, NY (US)). pp 646-648 of Proceedings of the 1987 IEEE particle accelerator conference: Accelerator engineering and technology. Lindstrom, E.R.; Taylor, L.S. Piscataway, NJ; IEEE Service Center (1987). (CONF-870302—).

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

An Ionization Profile Monitor (IPM) has been in use at the Brookhaven Alternating Gradient Synchrotron for several years to measure the horizontal and vertical profiles of the circulating beam. The device, which collects ions from the interaction of the beam with residual gas molecules, gives a fast, non-destructive readout, measuring the entire beam profile in a short time interval. It covers a large dynamic range, from less than 10^{10} to over $2x10^{13}$ protons per pulse, when the signal level is adjusted by controlling the local gas pressure and the integrating time. It can see changes in the beam with a time resolution of about 0.1 ms, except at low intensities where longer integration times are needed to get sufficient signal strength. However, the forces due to the space-charge of the circulating beam cause the ions to move in a curved path to the collector, distorting the profile and changing the measured beam size. In the worst situation at the AGS - high current beams at high energy, when the size has damped down to less than 2mm rms width - this distortion is substantial and must be understood and corrected, if possible, to properly interpret the measured beam sizes. This paper develops a model for this distortion, and formulas for correcting it. It is shown that the distortion is more severe than originally recognized, and that accurate quantitative measurements at the highest beam densities in the AGS are not possible. At lower densities, however, the correction is small and the IPM can give a good beam size measurement.

40902 **SuperHILAC real-time velocity measurements.** Feinberg, B.; Meaney, D.; Thatcher, R.; Timossi, C. (Lawrence Berkeley Lab., Univ. of California, Berkeley, CA (US)). pp 649-651 of Proceedings of the 1987 IEEE particle accelerator conference: Accelerator engineering and technology. Lindstrom, E.R.; Taylor, L.S. Piscataway, NJ; IEEE Service Center (1987). (CONF-870302—). Contract AC03-76SF00098.

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

Phase probes have been placed in several external beam lines at the LBL heavy ion linear accelerator (SuperHILAC) to provide non-destructive velocity measurements independent of the ion being accelerated. The existing system has been improved to provide the following features: a display refresh rate better than twice per second, a sensitive pseudo-correlation technique to pick out the signal from the noise, simultaneous measurements of up to four ion velocities when more than one beam is being accelerated, and a touch-screen operator interface. These improvements allow the system to be used as a routine tuning aid and beam velocity monitor.

40903 **The Argonne beamline-B telescope control system: A study of adaptability.** Fuka, M.A.; Clout, P.N.; Conley, A.P.; Hill, J.O.; Rothrock, R.B.; Trease, L.L.; Zander, M.E. (Los Alamos National Lab., Los Alamos, NM (US)). pp 652-654 of Proceedings of the 1987 IEEE particle accelerator conference: Accelerator engineering and technology. Lindstrom, E.R.; Taylor, L.S. Piscataway, NJ; IEEE Service Center (1987). (CONF-870302—).

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

A beam-expanding telescope to study high-precision H^- particle optics and beam sensing was designed by the Accelerator Technology Division at Los Alamos National Laboratory and will be installed on beamline-B at Argonne National Laboratory. The control system for this telescope was developed in a relatively short period of time using experience gained from building the Proton Storage Ring (PSR) control system. The designers modified hardware and software to take advantage of new technology as well as to meet the requirements of the new system. This paper discusses lessons learned in the process of adapting hardware and software from an existing control system to one with rather different requirements.

40904 **Mixing, staging and phasing for a proton-driven wake field accelerator.** Gai, W.; Ruggiero, A.G.; Simpson, J.D. (Argonne National Lab. (US)). pp 118-120 of Proceedings of the 1987 IEEE particle accelerator conference: Accelerator engineering and technology. Lindstrom, E.R.; Taylor, L.S. Piscataway, NJ; IEEE Service Center (1987). (CONF-870302—).

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

In this paper the authors expand on few important details of the Wakeatron concept. This is a device where electrons can be accelerated by the wake field of short intense proton bunches travelling along the axis of an rf structure. Specifically, the authors examined the consequences of the longitudinal dynamics of both the electron and the proton bunches. Included were "mixing" in the proton bunches (crucial to the overall concept) and phase shifts (electron bunches relative to proton bunches) in the acceleration process. Because of the deterioration of the proton bunches, due to the "mixing" process, it is required that the Wakeatron is indeed staged in a number of consecutive sections.

40905 **Advanced accelerator concepts and electron-positron linear colliders.** Siemann, R.H. (Accelerator Div., Fermi National Accelerator Lab., Batavia, IL 60510 (US)). pp 243-266 of Annual review of nuclear and particle science, Volume 37. Jackson, J.D. Palo Alto, CA; Annual Reviews Inc. (1987).

Advanced accelerator concepts and their application to high energy physics are reviewed. While the concepts selected do not make an all-inclusive list, they are those receiving substantial attention in the accelerator community. To be cost-effective for particle physics, small emittance beams and high acceleration efficiency are required. This is having a strong impact and is a stringent criterion for evaluation. Experiments aimed at proving essential features are in progress or beginning soon. These experiments include the FEL power source, the wakefield transformer, the switched power accelerator, the beatwave accelerator, and the plasma wakefield accelerator. In addition, computer simulations are exploring issues related to using these concepts in complete accelerator systems. Concepts that look promising in the proof-of-principle and simulation stages will soon be ready for detailed engineering. Prototype design to develop this engineering will play an increasingly important role in meeting the challenge of e/sup +/ e/sup -/ collisions at very high energies.

40906 **Emittance growth and transverse motion damping of the ATA electron beam with a small diameter laser ion channel.** Struve, K.W.; Caporaso, G.J.; Cole, A.G.; Weir, J.T. (Lawrence Livermore National Lab. (US)). pp 95 of The 1987 IEEE international conference on plasma science (Abstracts). Piscataway, NJ; IEEE Service Center (1987). (CONF-870651—).

From IEEE international conference on plasma science; Crystal City, VA, USA (1 Jun 1987).

The Advanced Test Accelerator (ATA) (50 MeV, 10 kA, 50 ns pulse, 1 Hz repetition rate) has been operated several years with a laser guiding scheme through the Accelerator to overcome the beam breakup instability. Growth of transverse beam motion has been controlled by focusing from the laser produced ion channel, which is somewhat larger than the electron beam. The ATA has also been operated with a higher density ion channel which has a much smaller diameter than the electron beam. In this mode the ion channel provides strong damping of transverse beam motion by phase-mixed damping with the added cost of beam emittance growth. Predictions of damping rates and emittance growth versus channel strength for the small channel mode are compared to experimental observations.

40907 **The scaling of linear supercolliders using modified SLAC structures.** Chernin, D.; Mondelli, A. (Science Applications International Corp., 1710 Goodridge Drive, McLean, VA (US)). pp 148-150 of Proceedings of the 1987 IEEE particle accelerator conference: Accelerator engineering and technology. Lindstrom, E.R.; Taylor, L.S. Piscataway, NJ; IEEE Service Center (1987). (CONF-870302—).

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

The development of a linear supercollider which can reach multi-TeV energies will require the use of high-gradient structures so that the size and cost of the accelerator can be minimized. Using frequencies higher than the SLAc frequency (2856 MHz) allows higher gradients to be achieved in smaller structures, at a cost of larger wakefields. The frequency scaling of rf linacs for a linear super-collider has been discussed in earlier publications. Here the authors discuss the tradeoffs involved in opening the aperture of a scaled SLAC structure. They find that wake effects can be reduced but the cost in terms of shunt impedance and peak rf power per feed may be prohibitive.

40908 **Aperture studies on RHIC for 30 and 100 GeV/nucleon operation with random and systematic magnet errors.** Dell, G.F.; Hahn, H. (Brookhaven National Lab., Upton, NY (US)). pp 1224-1227 of Proceedings of the 1987 IEEE particle accelerator conference: Accelerator engineering and technology. Lindstrom, E.R.; Taylor, L.S. Piscataway, NJ; IEEE Service Center (1987). (CONF-870302—).

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

Tracking studies on RHIC for the emittances and momentum spreads necessary for operation at 30 and 100 GeV/nucleon have been made when the effects of random and systematic magnet errors are included. All test particles are stable for the emittances required. Tune shifts from systematic b/sub 2/ are compensated by the chromaticity correcting sextupoles of the arcs. Tune shifts from systematic b/sub 3/ and b/sub 4/ are compensated by correction coils placed adjacent to the arc quadrupoles. The emittances required for operation are significantly smaller than the emittance corresponding to the dynamic aperature.

40909 **Analysis of optical perturbations of the SLC arcs.** Weng, W.T.; Sands, M. (Stanford Linear Accelerator Center, Stanford Univ., Stanford, CA (US)). pp 1221-1223 of Proceedings of the 1987 IEEE particle accelerator conference: Accelerator engineering and technology. Lindstrom, E.R.; Taylor, L.S. Piscataway, NJ; IEEE Service Center (1987). (CONF-870302—).

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

This paper is an attempt to establish the analytical framework in solving optical perturbations in a transport line in general and will be applied to the SLC Arc as an example. The formulation the authors present here should be applicable to any transport system in a straightforward way. In Section 2 the equations of motion of perturbed betatron function and dispersion function are presented and the driving terms identified. In Section 3, the sources of possible field errors for SLC Arc system are discussed. Finally, the authors estimate the magnitudes of perturbations to the optical functions for SLC Arc in Section 4.

40910 **Kiloamp high-brightness beams.** Caporaso, G.J. (Lawrence Livermore National Lab., Univ. of California, Livermore, CA (US)). pp 1001-1005 of Proceedings of the 1987 IEEE particle accelerator conference: Accelerator engineering and technology. Lindstrom, E.R.; Taylor, L.S. Piscataway, NJ; IEEE Service Center (1987). (CONF-870302—).

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

Brightness preservation of high-current relativistic electron beams under two different types of transprot is discussed. Recent progress in improving the brightness of laser-guided beams in the Advanced Test Accelerator is reviewed. A strategy for the preservation of the brightness of space-charge-dominated beams in a solenoidal transport system is presented.

40911 **The effect of nonlinear forces on coherently oscillating space-charge-dominated beams.** Celata, C.M. (Lawrence Berkeley Lab., Univ. of California, Berkeley, CA (US)). pp 996-1000 of Proceedings of the 1987 IEEE particle accelerator conference: Accelerator engineering and technology. Lindstrom, E.R.; Taylor, L.S. Piscataway, NJ; IEEE Service Center (1987). (CONF-870302—).

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

A particle-in-cell computer simulation code has been used to study the transverse dynamics of nonrelativistic misaligned space-charge dominated coasting beams in an alternating gradient focusing channel. In the presence of nonlinear forces due to dodecapole or octupole imperfections of the focusing fields or to image forces, the transverse rms emittance grows in a beat pattern. Analysis indicates that this emittance dilution is due to the driving of coherent modes of the beam near their resonant frequencies by the nonlinear force. The effects of the dodecapole and images forces can be made to effectively cancel for some boundary conditions, but the mechanism is not understood at this time.

40912 **Beam dynamics in the SLC final focus system.** Bambade, P.S. (Stanford Linear Accelerator Center, Stanford Univ., Stanford, CA (US)). pp 981-985 of Proceedings of the 1987 IEEE particle accelerator conference: Accelerator engineering and technology. Lindstrom, E.R.; Taylor, L.S. Piscataway, NJ; IEEE Service Center (1987). (CONF-870302—).

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

The SLC luminosity is reached by colliding beams focussed to about 2 μm transverse sizes. The Final Focus System (FFS) must enable, beyond its basic optical design, the detection and correction of errors accumulated in the system. In this paper, after summarizing the design, we review the sensitivity to such errors and the ability to correct them. The overall tuning strategy involves three phases: single beam spot minimization, steering the beams in collision and luminosity optimization with beam-beam effects.

40913 **Intense thermal electron-ion beam propagation properties with no applied magnetic field.** Striffler, C.D.; Yao, R.L.; Zhang, X. (Electrical Engineering Dept. and Lab. for Plasma and Fusion Energy Studies, Univ. of Maryland, College Park, MD (US)). pp 975-977 of Proceedings of the 1987 IEEE particle accelerator conference: Accelerator engineering and technology. Lindstrom, E.R.; Taylor, L.S. Piscataway, NJ; IEEE Service Center (1987). (CONF-870302—).

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

A steady-state, electron-ion beam propagation model is presented that self-consistently determines the downstream equilibrium properties of co-moving electron and ion beams in terms of upstream properties. Since there is no applied magnetic field, the presence of the ions is crucial to the downstream equilibrium. The ions are assumed to come from a localized source located near the entrance end of the injected electron beam. Each species has finite temperature in addition to a mean axial velocity. Downstream radial force balance leads to a Bennett radial density profile. Continuity of current and conservation of single particle energy lead to the self-consistent nature of the equilibrium and the determination of the localized ion source properties to achieve the equilibrium. The main quantitative result from the model is that an electron temperature exists where the equilibrium is nearly charge neutral and the ion mean velocity is near zero, that is, the ions provide no current neutralization. If the ion temperature is zero, this state represents the "traditional" Bennett pinch system.

40914 **Two cavity autoacceleration of an intense relativistic electron beam.** Coleman, P.D.; Lockner, T.R.; Poukey, J.W. (Sandia National Labs., Albuquerque, NM (US)). pp 969-971 of Proceedings of the 1987 IEEE particle accelerator conference: Accelerator engineering and technology. Lindstrom, E.R.; Taylor, L.S. Piscataway, NJ; IEEE Service Center (1987). (CONF-870302—).

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

Three series of experiments have been performed using two 40 Ω coaxial autoacceleration cavities to accelerate an intense relativisitic electron beam. First, conventional magnetic transport was used to propagate a 1.8 MeV, 11 kA beam through two 1 m long cavities. An increase of 700 +- 130 keV in kinetic energy was achieved which represents 80% of the maximum theoretical acceleration for an 11 kA beam passing through two 40 Ω cavities. Multiple accelerated pulses were generated and no adverse interaction between the cavities was observed. In the second experiment, Ion Focused Transport (IFT) was used to successfully propagate a 9 kA beam through the accelerator again achieving multi-pulse operation with both cavities. An energy increase of 560 +- 30 keV was attained which is 78% of the theoretical maximum. Finally, IFT was used to propagate a ≈ 25 kA beam through a 1 m long cavity, then a 0.5 m long cavity, demonstrating two stages of temporal energy compression. Gap leakage and current transport losses limited the acceleration to 1.25 +- .16 MeV which corresponded to an 84% increase in kinetic energy.

40915 **Trapping of the PHERMEX beam in a mirror field.** Hughes, T.P.; Builta, L.A.; Mack, J.M.; Moir, D.C. (Mission Research Corp., 1720 Randolph Rd., SE, Albuquerque, NM (US)). pp 966-968 of Proceedings of the 1987 IEEE particle accelerator conference: Accelerator engineering and technology. Lindstrom, E.R.; Taylor, L.S. Piscataway, NJ; IEEE Service Center (1987). (CONF-870302—).

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

An experiment is underway at Los Alamos National Laboratory to trap the 1-kA, 30-MeV PHERMEX beam in a magnetic mirror. The eventual aim is to accelerate the beam to 50 MeV by ramping up the magnetic field. Tangential injection of the beam through a soft iron nozzle is employed. Because the nozzle is placed within the magnetic mirror, energy must be extracted from the beam in one bounce time to prevent particles returning to the nozzle. A design to make the bounce time as long as possible is described, and two schemes to damp the axial motion are considered.

Numerical simulations of the device show considerable axial spreading of the beam in one bounce time. Estimates are made of negative mass instability growth rates and the damping to be expected from the experimentally measured beam energy spread. Experimental results obtained to date are described.

40916 **Laser-guiding of relativistic electron beams with applications to flash x-radiography.** Carlson, R.L. (Los Alamos National Lab., Los Alamos, NM 87545 (US)). pp 939-941 of Proceedings of the 1987 IEEE particle accelerator conference: Accelerator engineering and technology. Lindstrom, E.R.; Taylor, L.S. Piscataway, NJ; IEEE Service Center (1987). (CONF-870302—).

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

The technique of guiding a relativistic electron beam by utilizing an ultraviolet-laser-ionized channel in low-pressure benzene has been demonstrated on an rf linear accelerator. Detailed measurements of the temporal behavior of the beam as it propagated a distance of 13.5 m were made as a function of laser channel parameters and accelerator conditions. Concepts and applications of this laser-guiding technique are presented as they relate to the possible improvement and simplification of the generation, transport, and focusing of relativistic electron beams used to create bremsstrahlung radiation for flash x-radiography.

40917 **Comparison of electric and magnetic quadrupole focusing for the low energy end of an induction-linac-ICF driver.** Kim, C.H. (Lawrence Berkeley Lab., Univ. of California, Berkeley, CA (US)). pp 951-953 of Proceedings of the 1987 IEEE particle accelerator conference: Accelerator engineering and technology. Lindstrom, E.R.; Taylor, L.S. Piscataway, NJ; IEEE Service Center (1987). (CONF-870302—).

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

In this report the authors compare two physics designs of the low energy end of an induction-linac-ICF driver: one using electric quadrupole focusing of many parallel beams followed by transverse beam combining; the other using magnetic quadrupole focusing of fewer beams without beam combining. Because of larger head-to-tail velocity spread and a consequent rapid current amplification in a magnetic focusing channel, the overall accelerator size of the design using magnetic focusing is comparable to that using electric focusing.

40918 **Mechanical and magnetic alignment techniques for the RADLAC-II linear accelerator.** Armistead, D.J.; Bolton, D.L.; Mazarakis, M.G.; Peredo, R. (Sandia National Labs., Albuquerque, NM (US)). pp 942-944 of Proceedings of the 1987 IEEE particle accelerator conference: Accelerator engineering and technology. Lindstrom, E.R.; Taylor, L.S. Piscataway, NJ; IEEE Service Center (1987). (CONF-870302—).

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

The RADLAC-II beam line, which includes nine accelerating cavities, 25 solenoidal magnets, and a nine-cryopump vacuum system, is suspended from the top of a water tank by 60, 0.5 cm-diameter, stainless steel rods. There are seven swiveling joints providing beam line flexibility (similar to that of a spinal cord). The authors have developed a technique to mechanically align the — 12-meter-long accelerator vacuum pipe to within a fraction of a millimeter. A high accuracy microprocessor-equipped theodolite is being used with a television camera, monitor, and hard copier for observation ease, comparison, and documentation. Three illuminated lucite targets with cross hairs are utilized to align the beam line which comprises vacuum pipes of three different I.D.s. For the in-situ magnetic alignment of the solenoids, a new technique is currently being developed and will be presented.

40919 **Experimental results of beam brightness improvements at the Advanced Test Accelerator (ATA).** Weir, J.T.; Boyd, J.K.; Caporaso, G.J.; Orzechowski, T.J. (Lawrence Livermore National Lab., Univ. of California, Livermore, CA (US)). pp 934-935 of Proceedings of the 1987 IEEE particle accelerator conference: Accelerator engineering and technology. Lindstrom, E.R.; Taylor, L.S. Piscataway, NJ; IEEE Service Center (1987). (CONF-870302—).

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

The authors' experimental data showing improved brightness of Lawrence Livermore National Laboratory's Advanced Test Accelerator both at the injector and at the high-energy output. The effects of matching onto a laser-produced ion channel have been demonstrated, and an improved matching technique is now being used.

40920 **Acceleration and bending of a relativistic electron beam on the Sandia recirculating linac.** Shope, S.L.; Tucker, W.K.; Hasti, D.E.; Poukey, J.W.; Kamin, G.W.; Rienstra, W.W. (Sandia National Labs., Albuquerque, NM (US)). pp 917-919 of Proceedings of the 1987 IEEE particle accelerator conference: Accelerator engineering and technology. Lindstrom, E.R.; Taylor, L.S. Piscataway, NJ; IEEE Service Center (1987). (CONF-870302—).

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

Ion focused transport is used to generate and transport a relativistic electron beam in a recirculating linac. An ionized channel is formed in 0.06-0.2 mTorr of argon with a low energy e-beam that is contained and guided by a 200 G magnetic field. A 1.5-MeV, 20-kA beam has been generated in the injector and accelerated to 2.5 MeV by the accelerating cavity. Results of experiments on transporting and bending the beam through 270° are presented.

40921 **Nonlinear dynamics: A personal perspective.** Laslett, L.J. (Lawrence Berkeley Lab., Univ. of California, Berkeley, CA (US)). pp 519-580 of Nonlinear dynamics aspects of particle accelerators. Araki, H.; Ehlers, J.; Hepp, K.; Kippenhahn, R.; Weidenmuller, A.; Zittartz, J. New York, NY; Springer-Verlag New York Inc. (1986). (CONF-850114—).

From Joint US/CERN School on Particle Accelerators topical course on non-linear dynamics; Sardinia, Italy (31 Jan 1985).

The author says the phenomena discussed in other papers in this book have their implications in fields that extend far beyond the dynamics of particles in accelerators and storage rings. The field of astronomy certainly presents situations of obvious interest in this regard. To move outside of fields of physical science, it is noteworthy that quite simple and reasonable models for the annual change of populations of prey and predator can lead to astonishing oscillatory or erratic variations of the representative populations. The author suspects that similar effects might be seen in economic models. The sensitivity of behavior with respect to details of even quite simple models, as we have begun to recognize in some of our own work, surely should lead model makers to view their results with less than complete assurance. Issues the author discusses are: Development of Stochasticity from Area-Preserving Transformations; Limiting (Resonant) Frequencies for Particle Motion in the Median Plane of a Strong-Focusing Ring - Examples; Bifurcation.

4303 Auxiliaries And Components

REFER ALSO TO CITATION(S) 39435, 40648, 40745, 40811, 40829, 40839, 40901, 40903, 40909, 41020, 41035, 41081, 41736, 41986, 42400

40922 **(AD-A—189507/7/XAB) Development of electrostatic-accelerator free-electron lasers. Final report, 15 January 1980-30 April 1987.** Elias, L.R. (California Univ., Santa Barbara (USA)). 30 Apr 1987. 62p. NTIS, PC A04/MF A01.

A free-electron laser was developed, based on the utilization of a 6-MV electrostatic accelerator modified to generate relatively high-current electron pulses of sufficient intensity to allow its operation as an oscillator over a wide range of frequencies from the in-

frared (IR) to the far-infrared (FIR) region. The FEL began with the development of a unique, high-current, high-brightness electron gun; it continued with the successful demonstration of very high electron-beam recovery efficiency in 1983 and culminated with the operation of the FEL as an oscillator at wavelengths longer than 400 microns, and with the demonstration of laser operation at wavelength longer than 120 micrometers after upgrading the accelerator voltage from 3 to 6 MV. The major goal of the program is to develop a new breed of free-electron lasers based on the electron beams generated by electrostatic accelerators which would eventually be used as tools for scientific research in those regions of the spectrum where other coherent electromagnetic sources do not provide adequate power and/or continuous tunability. Much of the design and construction of the FEL hardware was done during Phase I. Initial testing of the hardware took place using a 3-MV accelerator made available to the FEL group. The construction and assembly of the FEL, as well as the first operation of the FEL, took place in the laboratory during Phase II. Finally, during phase III, the voltage of the accelerator was increased from 3 to 6 MV, in order to extend the operation of the FEL toward shorter wavelengths in the FIR region.

40923 (AD-A—191795/4/XAB) Self-excitation of a single-phase induction pulse-excited generator. Romanov, Y.A.; Sipaylov, G.A. (Air Force Systems Command, Wright-Patterson AFB, OH (USA). Foreign Technology Div.). 10 Oct 1985. 12p. (FTD-ID(RS)T—1628-84). NTIS, PC A03/MF A01.

Edited trans. of Tomskiy Politekhnicheskiy Inst. imeni S.M. Kirova, Mezhvuzovskiy Konferentsii po Elektronnym Uskoritelyam (USSR) Vol. 7, No. 8, 46-49(1970).

The question of the power feed of electromagnets which require high reserves of reactive energy takes on great urgency with the development and creation of powerful accelerators of charged particles. Both a continuous- and pulsed-power feed of the apparatuses is possible. Both forms of power supply can be accomplished if the storage devices of reactive energy, capacitive banks or electrical machine apparatus are used. In the development of electric-machine energy storage devices with the use of synchronous and homopolar generators, attention began to be paid to the induction (asynchronous) machine. Investigations on the use of induction generators in pulsed systems for the charging of capacitors are being conducted; These experimental studies are indicative of the prospect of similar synthetic schemes. Use of the induction generator with a capacitive excitation as the source of high pulsed power is indicated, and the possibility of the complete conversion of kinetic energy of the rotating masses into electromagnetic energy during one pulse is examined.

40924 (BNL—41296) Cryogenic systems for detectors and particle accelerators. Sondericker, J.H. (Brookhaven National Lab., Upton, NY (USA)). 1988. Contract AC02-76CH00016. 7p. (CONF-880466—4). NTIS, PC A02/MF A01;1; GPO Dep. Order Number DE88011415/JAW.

From Conference on superconductivity and applications; Buffalo, NY, USA (18 Apr 1988).

This paper discusses the cryogenic refrigeration systems used to cool coils and components at the Brookhaven RHIC. 4 refs., 3 figs. (LSP)

40925 (CONF-870610—23) Photon energy tunability of advanced photon source undulators. Viccaro, P.J.; Shenoy, G.K. (Argonne National Lab., IL (USA)). Aug 1987. Contract W-31-109-ENG-38. 14p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88010045/JAW.

From 5. national synchrotron radiation instrumentation conference; Madison, WI, USA (21 Jun 1987).

At a fixed storage ring energy, the energy of the harmonics of an undulator can be shifted or "tuned" by changing the magnet gap of the device. The possible photon energy interval spanned in this way depends on the undulator period, minimum closed gap, minimum acceptable photon intensity and storage ring energy. The minimum magnet gap depends directly on the stay clear particle beam aperture required for storage ring operation. The tunability of undulators planned for the Advanced Photon Source with first harmonic photon energies in the range of 5 to 20 keV are discussed. The results of an analysis used to optimize the APS ring energy is presented and tunability contours and intensity parameters are presented for two typical classes of devices.

40926 (IFVE-OEA—87-51) Channel for accelerating voltage amplitude control in the IHEP booster. Bruk, V.L.; Vorob'ev, V.K.; Ovinnikov, V.A.; Tishin, V.G. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1987. 14p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703176/JAW.

The structure of a channel for accelerating voltage amplitude control in the IHEP proton booster synchrotron ensuring the high efficiency of particle adiabatic synchrotron capture to the acceleration regime close to 100% is described. The blockdiagram of the channel is given. Basic parameters of a functional generator, control unit, a device for total accelerating voltage control and analog-to-digital converter forming the channel are considered. Operation of the channel during a year revealed its high reliability. 12 refs.; 5 figs.

40927 (IFVE-OEA—87-57) Auxiliarity modules for the SUMMA serial highway. Vetrov, P.B.; Mamakov, P.V.; Nikonov, S.V.; Trushin, K.I. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1987. 15p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703177/JAW.

A modulus of the SK-137 sorter-coder of demands and a modulus of the U-port adapter designed for expansion of opportunities and application of the SUMMA serial highway are described. The SK-137 modulus exercises sorting and priority coding of service request. Twelve commands of the frame channel implemented by the sorter-coder are given. The SK-137 modulus may be applied in systems for experimental data collection and processing as well as in automated systems of radiation control. The AM-190 adapter modulus ensures operability of the SUMMA serial highway on an auxiliary communication channel under the noise conditions at large distances between the frames. The modulator exercises data signal multiplexing and produces a phase-modulated signal coming to the linear transducer and transformer. The modulus of the adapter is successfully used in the system of interpanel data exchange of the automated systems for beam diagnostics and extraction as well as the radiation control system. 6 refs.; 6 tabs.; 4 figs.

40928 (IFVE-OEA—87-77) Two methods of beam position signal processing for closed orbit measurement. Bruk, V.L.; Morozov, I.G.; Tishin, V.G. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1987. 6p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88703179/JAW.

This paper describes two methods of processing lineraly detected signals of the beam position from pickup electrodes. The first method is based on the tracking self-balanced analog-digital bridge and the second one is based on the tracking ADC with varying reference. The operating features of the units realizing these methods are presented. 5 refs.; 2 figs.

40929 (IFVE-OI—87-36) Operative control of the process of HF training of the resonators for the injector into a booster. Zenin, V.A.; Chimankov, M.N. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1987. 6p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88703185/JAW.

HF-training of resonators is conducted during ion linac start-up and in the course of its operation to obtain the facility stable operation under the HF-field nominal levels. The resonator training degree is usually determined by the reduction of break-down number per unit of time up to the minimum and with the help of HF-pulse envelope shape control. However, it is not possible to gain complete data on the whole accelerating channel state using only this information. Resonator training degree operative control methods, based on measuring the intensity of x radiation, occuring under HF-power introduction into the resonators, are described.

Experimental results on HF-training of resonators and determination of points with increased secondary emission along the accelerating channel of the injector into the booster are presented. 3 refs.; 5 figs.

40930 **(IFVE-OKU—87-16) Possibility of simultaneous slow beam extraction in two independent directions.** Aseev, A.A.; Lyudmirskij, Eh.A.; Fedotov, Yu.S. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1987. 8p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88703186/JAW.

The possibility of simultaneous proton slow extraction (SE) from the IHEP accelerator in two independent directions is discussed. The variant of a double septum magnet with arrangement ensuring beam extractions to the channels 21, 22, 23, 24 are suggested for realization of this possibility. High-efficiency fast extraction to the channel 8 is realized over a shorter path ensuring less irradiation of the equipment. The possibilities of internal target operation with SE as well as extraction of classically scattered protons into any of the mentioned channels are conserved. 5 refs.; 6 figs.

40931 **(IFVE-OKU—87-30) Septum magnet with thin current sheet for the system of proton beam extraction from the IHEP acceleration.** Ado, Yu.M.; Lyudmirskij, Eh.A. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1987. 16p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703187/JAW.

Septum magnet with 0.5 mm-thick current sheet, developed for the system of slow and fast proton beam extraction from the IHEP accelerator, is described. Septum magnet may be used in accelerators with high and ultrahigh vacuum. Thermal loss removal from the current sheet is performed by the peripheral cooling system at the expense of thermal conductivity mechanism. Cooling system sink is placed outside the vacuum system as well as the magnet core and excitation coil reverse conductor. The current sheet insulation is radiation resistant and permits heating up to 300 deg C. The magnet is characterized by low gas release in the vacuum volume under residual gas pressure of up to 1x10/sub -8/ Pa. As refers to accelerated beam orbit the septum magnet may be adjusted with high precision: in radial coordinate-within+- 5 mm limits, in angular coordinate +-2x10/sup -3/ rad. Septum magnet has undergone bench tests and made 40000 cycles under different regimes. The number of operaions exceeded 500 thousand at the accelerator with proton extraction under operating conditions. 7 refs.; 7 figs.

40932 **(IFVE-OKU—87-37) Multiturn septum magnets for proton beam extraction from the IHEP accelerator.** Ado, Yu.M.; Dajkovskij, A.G.; Ershov, S.Yu.; Lyudmirskij, Eh.A. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1987. 16p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703188/JAW.

Structure of multiturn septum magnet for he systems of proton beam extraction from the IHEP accelerator is described. Excitation coil, magnet core and all communications are located outside the accelerator vacuum volume. The magnet is characterized by a low gas release to the vacuum volume under the residual gas pressures of up to 1x10 /sup -8/Pa. The transition from monoturn excitation coil to multiturn one allowed one to decrease the value of necessary current and thus to reduce the energy loss in the bus duct from the power supply source to septum magnet. This allows one to increase the duration of slow proton extraction under the same power consumption. For example, after transition to two- and four-turn septum magnets the slow extraction duration can be increased up to two seconds, i.e.-doubled, which opens up a possibility to organize the particle beam extraction along two separate transport channels. By the present time the septum magnet has made 300000 cycles within the framework of physical experiments.

40933 **(IFVE-ONF—87-50) On-line current transformer calibration with automatic control.** Belikov, S.V.; Godov, A.G.; Gurzhiev, S.N. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1987. 6p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88703189/JAW.

Possibilities of a more precise measurement of proton beam intensity using a current transformer (CT) on he basis of a new method of its calibration are considered. CT calibration is performed using C/sub cal/ capacity, charged from calibration voltage source. The capacity is discharged through the transformer calibration turn, imitating the passage of a proto beam with the intensity I=(C/sub cal/xv/sub cal/)/e, where v/sub cal/ is calibration voltage, e is the proton charge. Circuit in he secondary winding is an oscillatory circuit. During the calibration capacitor discharge a current pulse and then-resonance oscillations occur in the secndary winding. Resonance oscillation amplitude at the maximum point is proportional to the charge which has passed through to calibration turn. So, unambiguous correspondence between the intensity of the proton beam, which has passed through the transformer ring and CT responce signal amplitude can be ascertained.

40934 **(IFVE-OP—87-14) Studying the lithium lens in the IHEP 70-GeV proton beam.** Bayanov, B.F.; Boldyrev, E.M.; Evtikhiev, A.V. and others. (AN SSSR, Novosibirsk. Inst. Yadernoj Fiziki). (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1987. 12p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703191/JAW.

The results of testing a cylindrical lithium lens in a fast-extracted proton beam of the IHEP accelerator are described. The diameter and length of working area of the lens are equal to 0.5 and 10 cm respectively. Maximum field on the surface of the lithium cylinder is 96 kGs (focus distance is 0.62 m). Characteristics of the beam focused by the lens are presented. The conducted studies confirm good agreement of real optical properties with the calculational ones. All the technical systems operated rather reliably for a long time. But more strict limitations for instability of proton beam parameters or application of lenses with large (1.5-2 times) apertures are necessary to avoid undesirable effects associated with passage of a part of the beam outside the aperture. 7 refs.; 10 figs.

40935 **(IFVE-OP—87-70) Magnet with asbestos-cement insulation of coils.** Afanas'ev, V.V.; Berenyuk, M.A.; Biryukov, V.V. and others. (Moskovskij Inzhenerno-Stroitel'nyj Inst. (USSR)). (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1987. 18p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703192/JAW.

Problem of creating radiation stable insulation for magnet element coils withstanding radiation loads of above 5X10 Gy appeared in result of growth of accelerator energies and intensities. Magnet structure and technology for coil fabrication with asbestos-cement insulation are described. Results of magnetic measurements are presented. Special bay was constructed for the development of technology for fabricating coils with asbestos-cement insulation. The coil for three meter model magnet, designated for operation in the zone of target stations of hadron channels in experimental base of accelerating and storage facility was fabricated. Principle possibility of fabricating coils with asbestos-cement insulation on the base of domestic cements and asbestos was demonstrated. 14 refs.; 9 figs.; 2 tabs.

40936 **(INIS-SU—29/A) Excitation of symmetrical electric oscillations in the system of two different length and diameter section of the circular waveguide.** Misyura, N.N.; Sologub, V.G. (AN Ukrainskoj SSR, Kharkov. Inst. Radiofiziki i Ehlektroniki). 1986. 45p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703280/JAW.

Preprint–314.

The problem of excitaion of symmetrical oscillations by longitudinal electrical dipole in the system of two coaxial different

length and diameter finite sections of the circular waveguide is calculated using the partial inversion method based on the solution of the Riemann-Hilbert problem for one section of the real axis. The case when the typical section dimensions are comparable with the wavelength is investigated mainly. The influence of the diffractive connection between the waveguide sections on the spectrum and amplitudes of the excited oscillations in the dependence of the sections position and their typical dimensions the oscillation source position and the wavelength is elucidated. The influence of the double cylindrical screen situated on the perfectly conducting surface, on the radiation of antennae in near-horizon directions is studied.

40937 **(ITEF—142(1987)) Alignment of multisectional linear accelerator with modulated electrodes.** Vinogradskij, N.N.; Zarubin, A.B.; Malyshev, A.I.; Nesterov, N.A.; Porubaj, N.I.; Semenov, D.V. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1987. 15p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703310/JAW.

Methods of alignment of 12 m length heavy ion multisectional linear accelerator is described. Alignment of accelerator is carried out in three stages: preliminary arrangement of sections with modulated electrodes on accelerator axis with the accuracy from 0.3 to 0.5 mm, lateral alignment and longitudinal arrangement. For lateral alignment the optical sighting method permitting to carry out this procedure with an accuracy up to 0.1 mm is used. Longitudinal arrangement of sections with modulated electrodes is carried out using gauge blocks providing an accuracy of positioning electrodes of adjacent sections from 0.05 to 0.1 mm. 5 refs.; 8 figs.

40938 **(JAERI-M—88-064) Design of AVF-cyclotron beam transport system based on ion beam optics calculation.** Kamiya, Tomihiro; Yokota, Watalu; Arakawa, Kazuo. (Japan Atomic Energy Research Inst., Tokyo). Mar 1988. 43p. (In Japanese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88753643/JAW.

For the first step of designing the ion beam transport system of AVF-cyclotron (maximum proton energy: 90 MeV), the first order ion beam optics calculation on nine main beam courses was made using computer program 'TRANSPORT'. Each beam course was divided into several units and they were designed as telescopic as possible to make adjustment of ion beam transport simple and easy. Furthermore, they were designed to be as achromatic as possible to obtain the highest ion beam transmission. The layout of the transport system and beam envelopes were shown.

40939 **(JINR—9-87-379) Creation and start of the axial injection system for U-200 cyclotron.** Bekhterev, V.V.; Vinogradov, Yu.B.; Gikal, B.N. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Reactions). 1987. 14p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88701651/JAW.

Axial injection system in the U-200 isochronous cyclotron is described. Characteristics of the optical elements, electrostatic inflector and other components of transport system are presented. Ion source is described. First results of transport and acceleration of He ion beam are shown. The maximal efficiency from analysing magnet to final radius acceleration is equal to 3.8%, the current is 0.36 μA. Experimental results are in good agreement with calculations. 9 refs.; 16 figs.; 2 tabs.

40940 **(JINR—9-87-626) Link with high frequency generator and tuning of resonance frequency of U-400M cyclotron accelerating system.** Andriyanov, A.M.; Buj Binh Thuan; Gul'bekyan, G.G.; Ivanov, Eh.L. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Reactions). 1987. 7p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88703331/JAW.

The results of calculations of inductive and capacitive link of the U-400M cyclotron accelerating system with a high frequency generator are presented. The results of both experimental and theoretical investigations of the frequency turning of the U-400M cyclotron accelerating system using the tuning short coupling loop are presented. 4 refs.; 12 figs.

40941 **(JINR—13-87-704) Target for operation with hydrogen isotopes at pressures up to 1500 atm in the temperature range from 20.4 to 300 K.** Bystritskij, V.M.; Dzhelepov, V.P.; Zinov, V.G.; Stolupin, V.A.; Utkin, V.A.; Granovskij, V.B.; Kuts, V.A.; Chibisov, A.N. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems; AN Ukrainskoj SSR, Kiev. Inst. Geokhimii i Fiziki Mineralov). (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1987. 6p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88703335/JAW.

Submitted to the journal Prib. Tekh. Ehksp. .

To investigate mesoatomic and mesomolecular processes in mixture of hydrogen isotopes, a facility consisting of a gas target, a high pressure valve and a cryostat has been designed and made. The facility allows working with high pure hydrogen isotopes (total amount of impurities dose not exceed 10/sup -5/%) at pressures up to 1500 atm in the temperature range from 20.4 to 300 K. 6 refs.; 3 figs.

40942 (JINR—R-7-86-322, pp 74-75) **On-line control system for the U-400 cyclotron and multicharged ion source parameters.** Fefilov, B.V.; Malukhin, Yu.D.; Mel'nikova, L.M.; Pashchenko, S.V.; Rotaresku, E.; Sokolova, N.V.; Subbotin, V.G.; Sukhov, A.M.; Kim Zen Cher. 1986. (In Russian). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88780065/JAW.

In Heavy ion physics - 1985. Collection of annotations of the Nuclear Reaction Laboratory of the Joint Nuclear Research Institute works, 1985.

40943 (JINR—R-7-86-322, pp 76) **Transmission device for charged particle beam shape visual control.** Luk'yanov, S.L.; Chubaryan, G.G.; Khajdel', K. 1986. (In Russian). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88780065/JAW.

In Heavy ion physics - 1985. Collection of annotations of the Nuclear Reaction Laboratory of the Joint Nuclear Research Institute works, 1985.

40944 **(JINR-E—8-87-665) Cryogenic system of the prototype of the superconducting magnet for a deuteron cyclotron-1.** Alenitskij, Yu.G.; Buzdavin, A.P.; Vasilenko, A.T. and others. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1987. 6p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88703370/JAW.

Submitted to Tenth International conference on Magnet Technology, Boston, Massachusetts, 21 - 25 Sep 1987.

The results achieved in developing a cryogenic system for the superconducting magnet of the deuteron cyclotron are described. The cryogenic system consists of a liquefier-refrigerator with the output 40 l.h, or 150 W of power taken off at 4.5 K, a satellite refrigerator, a cryostat of the superconductiong magnet coil and vessels for liquid nitrogen and helium. Now auxiliary equipment is being mounted and the main parts of the magnet are being manufatured. 10 refs.; 2 figs.

40945 **(Juel-Spez—423) SAP/Al-Mg-Si composite alloy for use as a proton beam window of a high-power proton accelerator.** Schroeder, G.; Graf, K.H.; Lohmann, W.; Ribbens, A.; Fiorini, P.; Giordano, G. (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Zentralabteilung Allgemeine Technologie; Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Festkoerperforschung; Enka A.G., Obernburg (Germany, F.R.); Metallgesellschaft A.G., Frankfurt am Main (Germany, F.R.). Metall-Laboratorium; Aluminia S.p.A., Novara (Italy). Ist. Sperimentale Metalli Legeri). (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Zentralabteilung Allgemeine Technologie; Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Festkoerperforschung; Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Zentralabteilung Allgemeine Technologie; Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Festkoerperforschung; Metallgesellschaft A.G., Frankfurt am Main (Germany, F.R.). Metall-Laboratorium). Dec 1987. 29p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88754178/JAW.

A composite material consisting of a sintered aluminium product (SAP) core surrounded by an Al-Mg-Si alloy rim was studied with respect to its applicability as a stationary window inside a high-power proton beam. This paper summarizes the experimental procedures and results on both the composite material and individual SAP alloys in terms of materials preparation, microstructural characterization, leak tightness, deformation and burst behaviour, sensitivity to hydrogen embrittlement, and irradiation effects after helium preimplantation. Regarding any of these items, the material either proved good or showed only minor degradation. It is thus considered as promising for uses involving high thermomechanical load inside a high-radiation environment.

40946 (KEK—87-13, pp 1-6) **Radio frequency source for accelerator.** Baba, Hitoshi. (National Lab. for High Energy Physics, Oho, Ibaraki (Japan)). Sep 1987. (In Japanese). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88780097/JAW. (CONF-8706325—).

From Meeting on high-power, high-frequency power sources; Oho, Japan (4 Jun 1987).

Radio frequency sources of much greater power will be required in the future. This report presents some "unsuccessful" attemps made in developing or modifying various radio frequency sources for synchrotron linac, synchrotron main ring and Tristan. The first example cited is inner discharge breakdown in a connector, supplied by a French company, which was used to connect an RG117U coaxial cable with a WX-58D coaxial cable. It was found that the connector did not meet the requirements for imported components, suggesting that great care should be taken in adopting imported products. Dielectric breakdown occurred between the primary and secondary coils of a heater transformer in a power source for a linac, which resulted in secondary breakdown in a control connect, high-voltage capacitor and anmeter. This was attributed to inappropriate maintenance. An aluminum conductor in a WX-1500 wave guide was melted due to discharge heat resulting from insufficient tightening of a connecting frange, an unbelievable mistake made by experts. Other troubles occurred from insufficient knowledge, carelessness, insufficient experience, miscalculation, etc. (Nogami, K.).

40947 (KEK—87-13, pp 7-10) **Improvement in efficiency of pulse klystron for electronic linac.** Tomimasu, Takio; Kadono, Kin-ichi; Ogura, Koichi; Yamazaki, Takuo; Okamoto, Tadashi; Hosoi, Mari; Miyake, Setsuo; Unemura, Yukio. (Electrotechnical Lab., Sakura, Ibaraki (Japan)). Sep 1987. (In Japanese). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88780097/JAW. (CONF-8706325—).

From Meeting on high-power, high-frequency power sources; Oho, Japan (4 Jun 1987).

The original klystron consisted of four cavities placed at the same intervals. To improve this klystron, a fifth cavity (resonant cavity) was added, resulting in an increase in efficiency up to 49 percent. Another five-cavity klystron with a gain of 56 dB and efficiency of 54 percent was developed. In order to further improve this, modification was made to permit control of detuning characteristics of the third and forth cavity, and the arrangement of cavities were changed. In this report, a study is also made to determine the relations of the efficiency and cavity distance ratio of a pulse klystron for electronic linac. Results show: 1) The microwave output efficiency is greatly affected by the distance between cavity resonators, 2) The efficiency is greatly affected by the focusing coil current in a klystron, 3) A greater reduction in energy consumption can be achieved with higher-output klystrons, regardless of whether it is pulse type or continuous type (this denies the insistence by some researchers that an increase in efficiency of a pulse klystron will not make great contributions to reduction in energy consumption), and 4) It is very difficult to increase the efficiency to above 50 percent. (Nogami, K.).

40948 (KEK—87-13, pp 11-15) **Current status of radio frequency source for proton linac.** Takenaka, Tateru; Kato, Takao; Takasaki, Eiichi. (National Lab. for High Energy Physics, Oho, Ibaraki (Japan)). Sep 1987. (In Japanese). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88780097/JAW. (CONF-8706325—).

From Meeting on high-power, high-frequency power sources; Oho, Japan (4 Jun 1987).

This report deals with a proton linac radio frequency system which has been in operation for the past 13 years. It was enlarged in 1985 to increase the acceleration energy from 20 MeV to 40 MeV. Operation, modification and troubles with the radio frequency system after the enlargement are described. Before the enlargement, the ITT 1257 thyratron had a life of around or greater than one year. The main thyratron was replaced with the KU 275C type unit in 1986. They are different in average anode current and maximum anode voltage. As a result of the enlargement, the H.V. current increased greatly up to 2.5A (D.C.), which was very close to the rated average anode current of ITT 1257, leading to a decreased life of the bulbe. Other components replaced included rectifier diode, hold-off diode in the large power source, and trigger circuit. The TH 516 cavity and output line were improved to eliminate discharge. The bulbs are cleaned and the contactors of TH 516 filament electrodes are replaced each year during the regular maintenance period in summer. Checking of insulating oil, cooling systems, vaccum systems is also carried out during the maintenance period. (Nogami, K.).

40949 (KEK—87-13, pp 65-69) **RF source for proton linear accelerator in Kyoto University.** Iwashita, Yoshihisa. (Kyoto Univ., Uji (Japan). Inst. for Chemical Research). Sep 1987. (In Japanese). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88780097/JAW. (CONF-8706325—).

From Meeting on high-power, high-frequency power sources; Oho, Japan (4 Jun 1987).

Construction of a 433 MHz, 7 MeV proton linear accelerator is currently underway in Kyoto University under a three-year plan starting in 1986. The ion source, power source for it, RFQ main unit, WR2100 waveguide and a set of klystrons for RFQ were installed last year, or the first year of the plan, and the power source for the klystrons for RFQ, a set of klystrons for STL, DTL main unit, etc., are planned to be installed this year. Operation has not started yet because of the absence of the power source for the klystrons. Thus this report is focused on the considerations made in selecting the acceleration frequency of 433 MHz, specifications of the klystrons and the structure of the power sources for them. Based on considerations of the efficiency and cost of the accelerating tubes and RF sources to be used, the acceleration frequencies of 433.33 MHz and 1,300 MHz were adopted. The klystron selected is Litton L5773, which has a peak power output of 1.25 Mw, average power output of 75 kW, maximum pulse width of 2,000 μS and duty of 6 percent, and it consists of four cavities. The structure and characteristics of a klystron are also described. (Nogami, K.).

40950 (KEK—87-13, pp 70-76) **Power amplifier for RIKEN ring cyclotron.** Fujisawa, T.; Kohara, S.; Ogiwara, K.; Yokoyama, I.; Nagase, M.; Chiba, Y.; Kumata, Y. (Institute of Physical and Chemical Research, Wako, Saitama (Japan)). Sep 1987. NTIS (US Sales Only), PC A10/MF A01. Order Number DE88780097/JAW. (CONF-8706325—).

From Meeting on high-power, high-frequency power sources; Oho, Japan (4 Jun 1987).

The power amplifier for RIKEN ring cyclotron can generate an output power of 300 kW in a frequency range of 17 to 45 MHz. The final tube RS2042SK is used in grounded grid configuration. Load resistance matching is made by a variable capacitor inserted in series at its output port. The tuning element of the plate circuit is an adjustable quarter wave length coaxial stub whose stroke is 1.2 m. The cathode circuit consists of a quarter wave length coaxial stub and a variable tuning capacitor by which tuning and impedance matching are simultaneously carried out. The filament current is supplied through the stub from a power source at ground potential without a choke coil. All the systems were installed at the cyclotron vault in August 1986 and its performance studied. The SIEMENS RS2042, whose maximum plate dissipitation is 300 kW, is used as the final tubes. Its specification is shown. A schematic diagram of the power amplifier is given and the plate circuit used is described. The structure, tuning characteristics and input impedance of the cathode tuning circuit are outlined. Some results of a power test carried out are also described. (Nogami, K.).

40951 (KEK—87-13, pp 87-92) **Modification and numerical calculation for linac klystron modulator.** Takami, Kiyoshi; Kimura, Yasuhiro; Yamamoto, Shuji; Ozuka, Toshihiko; Kobayashi, Katsuhei; Fujita, Yoshiaki; Toyama, Isao. (Kyoto Univ., Kumatori, Osaka (Japan). Research Reactor Inst.). Sep 1987. (In Japanese). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88780097/JAW. (CONF-8706325—).

From Meeting on high-power, high-frequency power sources; Oho, Japan (4 Jun 1987).

An electron linear accelerator was installed in Kyoto University in 1965 to be used as a pulse neutron source. It originally consisted of an accelerating tube and a klystron, and another accelerating tube and klystron were added in 1972. Since then, various improvements and modifications have been made. Recently, it was decided to replace the U.S. Litton klystron with TV2022B, a product of French Thomson CSF. They were different in shape and characteristics, requiring a modification in the modulator. An additional No.2 modulator was constructed. But the modification did not give good results. To obtain knowledge on circuit actions and designing, a simulation study of circuit responses was made by using a personal computer. The model circuit used for the simulation contains two non-linear elements. Results of the simulation are shown for three cases. The simulation results served to obtain knowledge on circuit actions and were useful in deciding on the characteristics of components to be adopted for the modulator. The simulation model is expected to give better results if more parameters for non-linear characteristics are incorporated. (Nogami, K.).

40952 (KEK—87-13, pp 93-99) **Klystron pulse mudulator for linac.** Suzuki, Toshimitsu; Yasui, Minoru; Masaki, Toshiaki. (Mitsubishi Electric Corp., Amagasaki, Hyogo (Japan). Communication Equipment Works). Sep 1987. (In Japanese). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88780097/JAW. (CONF-8706325—).

From Meeting on high-power, high-frequency power sources; Oho, Japan (4 Jun 1987).

A highly stable klystron pulse modulator is required in constructing a linac with good beam characteristics. The De-Qing circuit has been used conventionally to stabilize the output of a pulse modulator, but this method can achieve a stability of 1 percent at best, which is far larger than the targeted stability (less than 0.1 percent). The following three types of regulators are available to stabilize the D.C. power source of a pulse modulator: series regulator, shunt regulator and switching regulator. Advantages and disadvantages of these regulators are examined and the shunt regulator is selected because of its simple circuit structure and easy adjustment. The klystron pulse modulator has the features of being able to serve as a component of a large-power pulse klystron, being high in pulse stability (reproducibility), giving good pulse profiles (free from evershoot or undershoot), being small in size, etc. The klystron pulse modulator consists of a power source step-up transfermer, three-phase full-wave rectifying circuit, smoothing circuit, constant voltage control circuit, switching circuit, PFN circuit and pulse transformer. (Nogami, K.).

40953 (KEK—87-13, pp 100-109) **TRISTAN MR klystron power source.** Ono, M.; Baba, H.; Takeuchi, Y. (National Lab. for High Energy Physics, Oho, Ibaraki (Japan)). Sep 1987. (In Japanese). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88780097/JAW. (CONF-8706325—).

From Meeting on high-power, high-frequency power sources; Oho, Japan (4 Jun 1987).

Two types of klystron power sources, Type A and Type B, are in use for the Tristan electron-positron collision ring (main ring). Type A is used to supply power to two klystrons while Type B for a single klystron. A power source consists of separate power supply components for the cathode, anode-heater and focusing/prefocusing coils of each klystron. For the crowbar switch, an equivalent circuit is used to determine the inflow current and estimates are compared with data. The comparison reveals that the crowbar switch satisfactorily meets the requirements for the protection of the klystrons. The actuation of a crowbar switch will have a rather large effect on other power sources, resulting in various noises. Thus improvements and modifications are required against these noises. Discussion is also made on the control of klystron beam current. Signals obtained through detection of the drive power and the pattern signals (Vc-loop reference signals) are used for controlling the anode voltage. The final part of the report describes an actual case where the actuation of a crowbar switch had a large effect on power sources installed along the Tristan main ring. (Nogami, K.).

40954 (KEK—87-13, pp 132-135) **Pulse klystron for linac.** Ieyoshi, Yoji; Hayashi, Kazutaka; Yamashita, Shinichi. (Mitsubishi Electric Corp., Amagasaki, Hyogo (Japan). Communication Equipment Works). Sep 1987. (In Japanese). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88780097/JAW. (CONF-8706325—).

From Meeting on high-power, high-frequency power sources; Oho, Japan (4 Jun 1987).

Mitsubishi Electric Corporation has developed many large-output pulse klystrons, such as PV-2012, PV-2014 and PV-3030A, to meet various requirements for radio frequency sources for small-sized linacs used in research facilities. This report describes some major aspects of klystrons which are currently being mass-produced, and large-output pulse klystrons to be developed in the future to be used for smaller-size linacs, SOR's and linear colliders. Structural features and major characteristics of pulse klystrons manufactured by the company are described. To develop larger-output systems, it is necessary to achieve the following; (1) improvement in withstand voltage of electron gun, (2) development of electron gun with increased perveance, (3) improved cavity design for higher efficiency, (4) development of output power cavity with increased withstand power, (5) development of output window with increased withstand power. Calculations are made to show parameters, including beam voltage, beam current, peak output, average output, pulse width, saturation gain and efficiency, which are required of future large-output klystrons. (Nogami, K.).

40955 (KEK—87-13, pp 153-162) **Characteristics of 1 MW klystron for Tristan MR.** Takeuchi, Yasunao; Baba, Hitoshi; Isagawa, Shigeru; Ono, Masaaki; Yoshida, Masato. (National Lab. for High Energy Physics, Oho, Ibaraki (Japan)). Sep 1987. (In Japanese). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88780097/JAW. (CONF-8706325—).

From Meeting on high-power, high-frequency power sources; Oho, Japan (4 Jun 1987).

In the Tristan accelerator installed in the National Lab. for High Energy Physics(KEK), two and twenty 1 MW klystrons are used for its accumulation ring and main ring, respectively, as radio frequency sources. Ten of them are VALVO's YK1303 and the remaining 2 are Toshiba's E3786. In particular, E3786 was developed jointly by KEK and Toshiba Corporation. In this report, these two types of 1 MW klystrons are compared from a viewpoint of users. The heater power is about 622 W for YK1303 and 308 W for E3786. This difference comes from the difference in structure of their cathode and heater. E3786 is considerably greater than YK1303 in gain and efficiency because of its improved basic design for the cavities, etc. E1786 is much smaller in ion pump current. Their performances at the time of installation are compared in

terms of the relations of anode voltage, etc., with saturated RF output, efficiency and phase change. The structures of the focussing coils, collectors and RF windows of YK1303 and E3786 are also compared. E3786 is equipped with a coaxial plate type alumina ceramic window coated with tin. Some troubles experienced with these klystrons are also outlined. (Nogami, K.).

40956 (KEK—87-13, pp 163-172) **Status of linac klystrons in photon factory.** Fukuda, Shigeki; Anami, Shozo; Saito, Yoshio; Shidara, Tetsuo; Homma, Hiroyuki; Nakao, Katsumi; Hanaki, Hirofumi; Matsuda, Namio; Tanaka, Jiro. (National Lab. for High Energy Physics, Oho, Ibaraki (Japan)). Sep 1987. (In Japanese). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88780097/JAW. (CONF-8706325—).

From Meeting on high-power, high-frequency power sources; Oho, Japan (4 Jun 1987).

An electron linac and positron accelerator are installed in the Photon Factory of National Lab. for High Energy Physics(KEK). A total of 41 and 6 large-power klystrons are used for the electron linac and positron accelerator, respectively. This report describes the current status of and troubles with these large-power klystrons. Permanent magnets are used for focusing in the electron linac. Some troubles occurred following its installation. Major ones resulted from inverse magnetic field characteristic of permanent magnets, large dependence of efficiency on the degree of axial symmetry of the magnetic field distribution, and large variations in optimum focusing magnetic field among different klystrons. Fault of a klystron is the most frequent cause of undesired suspension of the linac. The fault in this case refers to a temporary stop of the operation of a klystron as a result of actuation of the interlock system. Improvements have been made to eliminate these troubles, most of which are attributed to some deterioration caused by electric discharge in a klystron tube. Thus what is most important is to reduce the residual gas in the tube because it is very likely to cause discharge. (Nogami, K.).

40957 (KEK—87-13, pp 173-187) **Alumina window for large-power radio frequency source.** Saito, Yoshio; Matsuda, Namio; Anami, Shozo. (National Lab. for High Energy Physics, Oho, Ibaraki (Japan)). Sep 1987. (In Japanese). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88780097/JAW. (CONF-8706325—).

From Meeting on high-power, high-frequency power sources; Oho, Japan (4 Jun 1987).

Destruction of the window is a major trouble with a large-power radio frequency source. Material for a window should be resistant to super-high vacuum (10/sup -9/ - 10/sup -11/ Torr) in addition to the high vacuum range (10/sup -7/ - 10/sup -8/ Torr) and should be small in gas release rate. It should also be resistant to high temperature during baking and should not undergo dielectric breakdown due to discharge or dielectric loss. The optimum length of a cylidrical waveguide is determined based on measurement of the voltage to standing wave ratio (VSWR). VSWR should be low and should give a smooth curve over a wide frequency range around the frequency to be used. Heat due to dielectric loss will result in gas release and cracks in alumina ceramics. Thus tan δ should be low (about 10/sup -4/ at 1 GHz) and purity should be high (97 % or above). Microscopic structures should be examined well in addition to the specifications of the alumina product. Destruction of window are discussed in relation to observations of through holes, luminescence, surface melting and electron impact. Measurements show that the intensity of luminescence has close relations with the melting of alumina surface and formation of through holes. (Nogami, K.).

40958 (KEK—87-13, pp 194-197) **Large-power microwave circuit device.** Suzuki, Kunio. (Nihon Koshuha Co. Ltd., Yokohama (Japan)). Sep 1987. (In Japanese). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88780097/JAW. (CONF-8706325—).

From Meeting on high-power, high-frequency power sources; Oho, Japan (4 Jun 1987).

A 250 KW CW circulator and 1 MW CW dammy load are developed as large-power microwave circuit devices for Tristan, and they are shown to have good characteristics. The circulator has a Y-shape and consists of waveguides divided into four parts. Partition plates are provided in the waveguide connected to each port in order to divide the power into four components. A ferrite material which is high in Curie temperature and less likely to suffer from a RF loss is selected to be used in the circulator. Thin disks of this material, which is low in temperature gradient in the direction of thickness, are bonded to the surface of the waveguides with an epoxy adhesive. A magnet is provided at the top and bottom of the main portion of the circulator and the magnetic field is adjusted so that optimum characteristics are achieved. These arrangements result in good electrical and power characteristics. The dammy load of a water loading type is selected because microwave power is easily absorbed in water. A mechanically strong pipe which does not cause a large loss in microwave is mounted in a waveguide and water is passed through it to allow the power to be consumed gradually. A test up to a RF power of 750 KW shows that the temperature rise in the waveguide is 30 deg C. (Nogami, K.).

40959 **(KEK—87-16) Impedance of separators at low frequencies.** Ng, King-Yuen. (National Lab. for High Energy Physics, Oho, Ibaraki (Japan)). Sep 1987. 8p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88753646/JAW.

Separators are used in e/sup +/-e/sup -/ collider to separate the electron and positron bunches from collision during injection. When the injection stage is finished, the electrostatic potentials on the separators are turned off so that the bunches can collide. However, on passing through the separators, a bunch still sees a discontinuity and experiences an impedance. In a usual collider, besides radiation, the energy lost to the separators is rather significant. Therefore, an estimate of the impedance is necessary. In the present study, an attempt is made to compute both the longitudinal and transverse impedances of a pair of separators. The model used is a lumped equivalent circuit in which the transmission of current takes zero time and the separator plates are regarded as perfect conductor. As a result, it is found that the impedances are good at low frequencies only. Also, casuality is violated in the model used. Because of this, the impedances do not satisfy Hilbert transformation. The computation of loss factors may also be affected by these assumptions. To improve the model, it is necessary to consider the finite rate of transmission across the separators. This brings in many propagating modes at high frequencies and the problem will become very complicated. (Nogami, K.).

40960 **(KEK—87-21) Design concept for a direct water-cooled silicon crystal for use in a high-power synchrotron radiation beam.** Oversluizen, T. (National Lab. for High Energy Physics, Oho, Ibaraki (Japan)). Nov 1987. 23p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88754135/JAW.

The onset of high-power Synchrotron Radiation beams, now available at several of the Synchrotron Radiation facilities, has resulted in a search for new ways on how to handle the increased thermal load on optical components that are directly exposed to these beams. This report examines one possible way of the direct water-cooling of a silicon crystal as used in monochromators and how to get the water to the crystal with the least possible strain on the crystal. Suggestions are made on how to mount the crystal assembly in an experimental setup, so that physical properties of the crystal can be measured during direct exposure to a suitable high-power Synchrotron Radiation beam. Ways of making small correction movements to the crystal in two directions are outlined.

40961 **(KEK—87-22) Pulsed quadrupole magnet systems for the polarized beam acceleration at the KEK 12 GeV PS.** Sato, Hikaru; Arakawa, Dai; Hiramatsu, Shigenori; Toyama, Takeshi. (National Lab. for High Energy Physics, Oho, Ibaraki (Japan)). Dec 1987. 37p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88754136/JAW.

Design and operation of the pulsed quadrupole magnets to correct the intrinsic depolarizing resonances in the KEK PS are described. Rise time of the pulsed quadrupole magnets is set to correct resonances corresponding to each resonance strength. Conventional pulsed quadrupole magnets made of thin steel plate of 0.1 mm thick are good enough to jump the resonance and the power supplies are made simply and inexpensively.

40962 (KFTI—87-45) Program-calculation complex for polarization experiments at the Kharkov 2 GeV electron linear accelerator. Bratashevskij, A.S.; Gritchina, I.V.; Gushchin, V.A. and others. (AN Ukrainskoj SSR, Kharkov. Fiziko-Tekhnicheskij Inst.). 1987. 14p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703445/JAW.

Systematic polarization investigation of photonucleon and photonuclear reactions are carried out at LUEh-2 GeV linear electron accelerator of KhFTI have been carried out for some years. Possibility to obtain more complete information on polarization parameters is connected with the necessity to carry out simultaneously polarization measurements at some experimental installations under on-line mode. A program-calculation complex (PCC) of polarized measurements is developed and designed to provide realization of the KhFTI experiments mentioned above. The PCC developed provides data acquisition and accumulation from wire spark chambers, data on measurement by semiautomatic decorders of stereoscopic photographs with a spark chamber telescope, data from the telescope of scintillation counters and polarization target transducer. The possibility to calculate Σ, T, P, G, H-polarization parameters under on-line mode of experiment conduction is provided. 11 refs.; 4 figs.; 1 tab.

40963 (KFTI—87-47) Automatic multichannel calorimetric device for the beam energy radial distribution analysis. Zeidlits, V.P.; Postol, V.V.; Tkach, Yu.V.; Pavlenko, N.G. (AN Ukrainskoj SSR, Kharkov. Fiziko-Tekhnicheskij Inst.). 1987. 8p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88703446/JAW.

The MKU-1 multichannel calorimetric device with high sensitivity for analysis of energy distribution in the space of relativistic electron beam (REB) with $<$ or $\sim$ 30 MeV energies for heat release in the absorber at beam cross-section dimensions 10...100 mm is described. Calculation of penetration depth in a sample for relativistic beams with 5, 10, MeV energies and calculation of temperature distribution in a copper sample depending on the depth of electron penetration are given. Preliminary measurements of relative radial distribution of energy beam with $\gamma \sim 20$ showed perspectivity of application of such a device when studying methods of REB focusing used for inertial thermonuclear synthesis. 10 refs.; 6 figs.

40964 (LA-UR—88-1058) Automation of particle accelerator control. Silbar, R.R.; Schultz, D.E. (Los Alamos National Lab., NM (USA)). 1988. Contract W-7405-ENG-36. 6p. (CONF-880719—4). NTIS, PC A02;3. Order Number DE88007821/JAW.

From ASME international computers in engineering conference and exhibition; San Francisco, CA, USA (31 Jul 1988).

We have begun a program aiming toward automatic control of charged-particle beam optics using artificial intelligence programming techniques. In developing our prototype, we are working with LISP machines and the KEE expert system shell. Our first goal was to develop a 'mouseable' representation of a typical beamline. This responds actively to changes input from the mouse or keyboard, giving an updated display of the beamline itself, its optical properties, and the instrumentation and control devices as seen by the operator. We have incorporated the Fortran beam optics code TRANSPORT for simulation of the beam. The paper describes the experience gained in this process and discusses plans to extend the work so that it is usable, in real-time, on an operating beamline. 11 refs., 2 figs.

40965 (RAL—88-026) New UA1 calorimeter trigger. Eisenhandler, E. (Rutherford Appleton Lab., Chilton (UK)). 1988. 11p. (CONF-880292—). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88754100/JAW.

From Institute of Physics meeting on techniques in triggering and data acquisition; Manchester, UK (17 Feb 1988).

The new UA1 first-level calorimeter trigger processor is described, with emphasis on the fast two-dimensional electromagnetic cluster-finding that is its most novel feature. This processor is about five times more powerful than its predecessor, and makes extensive use of pipelining techniques. It allows multiple combinations of triggers on electromagnetic showers, hadronic jets and energy sums, including a total-energy veto of multiple interactions and a full vector sum of missing transverse energy.

40966 (SAND—88-0424) Preoperational radiation studies for HERMES III using an indented-anode diode. Sanford, T. W. L.; Halbleib, J. A.; Poukey, J. W. (Sandia National Labs., Albuquerque, NM (USA)). Jun 1988. Contract AC04-76DP00789. 70p. NTIS, PC A04/MF A01;1; GPO Dep. Order Number DE88012749/JAW.

A model that has been tested experimentally on Helia is used to predict the radiation environment of the HERMES III gamma-ray simulator. This model demonstrates the potential capability that HERMS III will have for generating intense, uniform radiation exposures over areas from 500 to 2500 cm^2. 16 refs., 42 figs., 1 tab.

40967 (SAND—88-1158) The RADLAC-II module accelerator double pulse experiments. Smith, David L.; Mazarakis, Michael G.; Jones, Edwin E. (Sandia National Labs., Albuquerque, NM (USA)). Jun 1988. Contract AC04-76DP00789. 75p. NTIS, PC A05/MF A01;1; GPO Dep. Order Number DE88012746/JAW.

The RADLAC-II Module(RIIM) accelerator was converted to a double- pulse machine with a foilless-diode load. The injector performance was evaluated in the double-pulse mode for pulse separations less than 2 ms. Two different pulsed power configurations were used to compare two voltage regimes and the pulse-to-pulse coupling conditions. The higher voltage pulsed power configuration produced first-pulse electron beam parameters of 4 MeV, 20-30 kA, and 40 ns FWHM. The second pulse from the lower voltage configuration suffered much less jitter and inductive losses than the second pulse for the higher voltage case. In both cases, a gas phenomenon appeared to inhibit the generation of a second electron beam. The generated plasma and excessive neutral gas release inside the injector followed the first pulse and prevented the diode from producing a second beam pulse for interpulse separations larger than one microsecond. Prior to this "cut-off" time the lower voltage configuration did produce a second electron beam pulse of about 10 kA, similar to that of its first pulse. This report summarizes all the major results of the RIIM double- pulse experiments. The primary areas of interest and discussion include: first pulse performance, first pulse coupling and interference with the second pulse water switches, second pulse water switch jitter, additional losses of the second pulse, and injector plasma/gas interference with the second pulse. The restrictive range of operation we found for this injector should inspire research into alternative geometries, materials, and pumping techniques. 14 refs., 26 figs.

40968 (SLAC-PUB—4650) Relativistic klystron research for high gradient accelerators. Allen, M.A.; Callin, R.S.; Deruyter, H.; Eppley, K.R.; Fowkes, W.R.; Herrmannsfeldt, W.B.; Higo, T.; Hoag, H.A.; Lavine, T.L.; Lee, T.G. (Stanford Linear Accelerator Center, Menlo Park, CA (USA); Lawrence Berkeley Lab., CA (USA); Lawrence Livermore National Lab., CA (USA)). Jun 1988. Contract AC03-76SF00515;AC03-76SF00098;W-7405-ENG-48. 6p. (UCRL—98843; CONF-880695—17). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88012742/JAW.

From 1. European particle accelerator conference; Rome, Italy (7 Jun 1988).

Relativistic klystrons are being developed as a power source for high gradient accelerator applications which include large linear electron--positron colliders, compact accelerators, and FEL sources. We have attained 200MW peak power at 11.4 GHz from a relativistic klystron, and 140 MV/m longitudinal gradient in a short 11.4 GHz accelerator section. We report here on the design of our first klystrons, the results of our experiments so far, and some of our plans for the near future. 5 refs., 7 figs.

40969 **(SLAC-PUB—4662) Relativistic klystron research at SLAC and LLNL.** Allen, M.A.; Callin, R.S.; Deruyter, H.; Eppley, K.R.; Fowkes, W.R.; Herrmannsfeldt, W.B.; Higo, T.; Hoag, H.A.; Lavine, T.L.; Lee, T.G.; Loew, G.A.; Miller, R.H.; Morton, P.L.; Palmer, R.B.; Paterson, J.M.; Ruth, R.D.; Schwarz, H.D.; Takeuchi, Y.; Vlieks, A.E.; Wang, J.W.; Wilson, P.B.; Hopkins, D.B.; Sessler, A.M.; Barletta, W.A.; Birx, D.L.; Boyd, J.K.; Houck, T.; Westenskow, G.A.; Yu, S.S. (Stanford Linear Accelerator Center, Menlo Park, CA (USA); Lawrence Berkeley Lab., CA (USA); Lawrence Livermore National Lab., CA (USA)). Jun 1988. Contract AC03-76SF00515;W-7405-ENG-48;AC03-76SF00098. 7p. (CONF-880713—3). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88012744/JAW.

From 7. international conference on high-power particle beams; Karlsruhe, F.R. Germany (4 Jul 1988).

We are developing relativistic klystrons as a power source for high gradient accelerator applications such as large linear electron-positron colliders and compact accelerators. We have attained 200 MW peak power at 11.4 GHz from a relativistic klystron, and 140 MV/m longitudinal gradient in a short 11.4 GHz accelerator section. We report here briefly on our experiments so far. 5 refs., 1 fig., 1 tab.

40970 **Investigation into flow regimes for two-phase helium flow.** Theilacker, J.C.; Rode, C.H. (Fermi National Accelerator Lab., Batavia, IL (USA)). pp 391-398 of Advances in cryogenic engineering. Volume 33. Fast, R.W. (ed.). New York, NY; Plenum Press (1988). (CONF-8706125—).

From Cryogenic engineering conference; St. Charles, IL, USA (14 Jun 1987).

A test setup was constructed at Fermilab to investigate two-phase helium flow for conditions practical in accelerator designs. The setup consisted of a standard Tevatron satellite refrigerator, subcooling dewar, heater, transfer line, and a specialized end box. A knife blade at the end of the transfer line diverted the flow from the upper and lower halves of the pipe to separate vessels in the end box. The amount of liquid above and below the plane was measured at various total mass flow rates and liquid percentages. The results show that stratified flow occurs at much higher liquid percentages than predicted by the Baker diagram.

40971 **Tests of cold helium compressors at Fermilab.** Peterson, T.J.; Fuerst, J.D. (Fermi National Accelerator Lab., Batavia, IL (USA)). pp 655-662 of Advances in cryogenic engineering. Volume 33. Fast, R.W. (ed.). New York, NY; Plenum Press (1988). (CONF-8706125—).

From Cryogenic engineering conference; St. Charles, IL, USA (14 Jun 1987).

Fermilab has tested two compressors for possible installation in the satellite refrigerator buildings of the Tevatron cryogenic system. Both Creare Inc. and Cryogenic Consultants Inc. have supplied units for evaluation. The Creare machine, a high speed centrifugal pump/compressor, yielded 60% adiabatic efficiency but had difficulty withstanding two-phase flow. Cryogenic Consultants provided a reciprocating unit which achieved 59% efficiency and, although lacking the operating characteristics of the turbomachine, endured throughout testing and was insensitive to two-phase flow. Test results are discussed.

40972 **Cryogenic pulsed power transformers.** Rogers, J.D.; Eckels, P.W.; Hackworth, D.T.; Shestak, E.J.; Singh, S.K. (Los Alamos National Lab., NM (USA)). pp 1129-1135 of Advances in cryogenic engineering. Volume 33. Fast, R.W. (ed.). New York, NY; Plenum Press (1988). (CONF-8706125—).

From Cryogenic engineering conference; St. Charles, IL, USA (14 Jun 1987).

Three liquid nitrogen cooled transformers, two with 14.4 MJ and one with 33.5 MJ storage capacity, are being built to provide respective currents of 0.31 and 0.95 MA to drive a distributed rail gun and are designed to withstand respective voltages of 70 and 200 kV. The transformers are contained in fiberglass reinforced polyester plastic dewars to avoid eddy current coupling and lateral forces that would exist with a metal dewar. To improve the coupling between windings the secondary winding is made relatively thin and is supported structurally for magnetic loading against the outer primary winding. The coils are pool bath cooled. Normal and fault mode analyses indicated safe operation with some precautions for venting nitrogen gas provided.

40973 **Phase detector and phase feedback for a single bunch in a two-bunch damping ring for the SLAC linear collider.** Schwarz, H.D.; Judkins, J.G. (Stanford Linear Accelerator Center, Stanford Univ., Stanford, CA (US)). pp 769-771 of Proceedings of the 1987 IEEE particle accelerator conference: Accelerator engineering and technology. Lindstrom, E.R.; Taylor, L.S. Piscataway, NJ; IEEE Service Center (1987). (CONF-870302—). Contract AC03-76SF00515.

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

The synchronous phase of a bunch of positrons or electrons being damped in a SLAC Linear Collider (SLC) damping ring is dependent on beam intensity. Injection for alternate bunches into the SLC linac from the damping rings should occur at a constant phase. A phase detector was developed allowing the measurement of phase of a single-stored bunch in the presence of a second bunch in reference to the phase of the linac. The single-bunch phase is derived from beam position monitor signals using a switching scheme to separate the two bunches circulating in each damping ring. The hardware is described including feedback loops to stabilize the extraction phase.

40974 **Rf control system for a rocket-borne accelerator.** Lynch, M.T.; Sorum, L.N.; Keffeler, D.R. (Los Alamos National Lab., Los Alamos, NM (US)). pp 775-777 of Proceedings of the 1987 IEEE particle accelerator conference: Accelerator engineering and technology. Lindstrom, E.R.; Taylor, L.S. Piscataway, NJ; IEEE Service Center (1987). (CONF-870302—).

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

The Beam Experiments Aboard Rockets (BEAR) accelerator experiment imposes several nonstandard requirements on the rf control system. The experiment is entirely hands-off and must operate under local computer control. The rf control system must be extremely reliable, which implies excellence in design and fabrication as well as redundancy whenever possible. This paper describes the design of the frequency-source, frequency-control, and amplitude-control systems for the BEAR experiment.

40975 **Transverse beam dampers for the FNAL antiproton rings.** Petter, J.; Marriner, J.; McCarthy, J. (Fermi National Accelerator Lab., P.O. Box 500, Batavia, IL (US)). pp 791 of Proceedings of the 1987 IEEE particle accelerator conference: Accelerator engineering and technology. Lindstrom, E.R.; Taylor, L.S. Piscataway, NJ; IEEE Service Center (1987). (CONF-870302—).

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

A wide band damper system has been developed for the Fermilab Antiproton Source. The system includes both forward and reverse beam direction damping in the Accumulator and forward only in the Debuncher. The system is currently used to damp coherent instabilities in the Accumulator during antiproton accumulation and extraction. The Damper system is also useful as a diagnostic tool. This paper includes some details about the design of the system hardware. Specifically included are the design of the beam pickup preamplifiers, a correlator notch filter and 300 Watt 180° power splitters. Also included are measurements made to verify the system is working properly.

40976 **Beam transfer from the debuncher to the stacking orbit of the accumulator ring at Fermilab.** Bharadwaj, V.K.; Griffin, J.E.; Harding, D.J.; MacLachlan, J.A. (Fermi National Accelerator Lab., P.O. Box 500, Batavia, IL (US)). pp 1025-1027 of Proceedings of the 1987 IEEE particle accelerator conference: Accelerator engineering and technology. Lindstrom, E.R.; Taylor, L.S. Piscataway, NJ; IEEE Service Center (1987). (CONF-870302—).

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

This paper describes the transfer of a cooled beam of antiprotons from the Debuncher Ring to the stacking orbit of the Accumulator Ring at the Fermilab Pbar Source. At the end of a Debuncher beam cycle - currently every 2.8 seconds - a cooled debunched beam of antiprotons circulates in the Debuncher Ring. Horizontally and vertically this beam is smaller than 7 pi mm-mmrad Longitudinally the beam is cooled to a Dp/p of 0.2%.

40977 **Limits on the transverse phase space density in the Fermilab Booster.** Ankenbrandt, C.; Holmes, S.D. (Fermi National Accelerator Lab., P.O. Box 500, Batavia, IL (US)). pp 1066-1068 of Proceedings of the 1987 IEEE particle accelerator conference: Accelerator engineering and technology. Lindstrom, E.R.; Taylor, L.S. Piscataway, NJ; IEEE Service Center (1987). (CONF-870302—).

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

Recent results on intensity and transverse density limitations in the Fermilab 8-GeV Booster are presented. The evidence suggests that the limits are set by incoherent space-charge effects at low energy. Data are interpreted in terms of the space-charge tune shift and possible means of improving performance further are discussed.

40978 **Operational experience with bunch rotation momentum reduction in the Fermilab antiproton source.** Bharadwaj, V.; Griffin, J.E.; MacLachlan, J.A.; Martin, P.S.; Meisner, K.G.; Wildman, D. (Fermi National Accelerator Lab. (US)). pp 1084-1086 of Proceedings of the 1987 IEEE particle accelerator conference: Accelerator engineering and technology. Lindstrom, E.R.; Taylor, L.S. Piscataway, NJ; IEEE Service Center (1987). (CONF-870302—).

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

In the Fermilab antiproton accumulation system antiprotons are produced by the delivery of trains of 120 GeV proton bunches to a production target from which antiprotons are collected with mean energy 8 GeV (kinetic) and momentum spread Δrho/rho > 3%. The antiproton beam has the time structure of the incident protons. The proton bunch spacing-to-length ratio is made as large as possible (> 20:1) so that the resulting antiproton momentum spread may be reduced by "bunch rotation" in a "debunching" ring where time spread is exchanged for momentum spread. Details of these procedures are described elsewhere; in this paper the authors report on the efficacy of these procedures during routine operation.

40979 **Performance of Tevatron I core stochastic cooling systems.** Kells, W.; Marriner, J.; Pasquinelli, R.; Mtingwa, S. (Fermi National Accelerator Lab. (US)). pp 1090-1092 of Proceedings of the 1987 IEEE particle accelerator conference: Accelerator engineering and technology. Lindstrom, E.R.; Taylor, L.S. Piscataway, NJ; IEEE Service Center (1987). (CONF-870302—).

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

The Tev I antiproton Accumulator utilizes three "core" stochastic cooling systems: two identical (H and V) transverse systems; j and a momentum cooling system. All three incorporate similar hardware, working in the 2-4 GHz microwave band. After several commissioning periods those systems are found to work very nearly to the original design specifications. Cooling tests have been performed with ≤21 ma (1.8×10^{11}) antiprotons and ≤26 ma (2.6×10^{11}) proton beams.

40980 **Rf stability in the Los Alamos free-electron laser energy-recovery experiment.** Wang, T.S.F.; Takeda, H. (Los Alamos National Lab., Los Alamos, NM (US)). pp 1102-1104 of Proceedings of the 1987 IEEE particle accelerator conference: Accelerator engineering and technology. Lindstrom, E.R.; Taylor, L.S. Piscataway, NJ; IEEE Service Center (1987). (CONF-870302—).

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

The energy-recovery experiment (ERX) successfully completed at Los Alamos recently was designed to demonstrate efficiency improvement of a radio-frequency (rf) linac-driven free-electron laser. In the ERX, most of the power in the residual electron beam, after the wiggler, is extracted in a decelerator and is then coupled by bridge couplers to the accelerator for new beam-acceleration power. In this paper, the authors present an equivalent-circuit analysis of the rf stability for the ERX system. The authors' results indicate that the aperture of the beam-transport line imposes a severe limit on the system's stability. They also discuss the effect of phasing between the decelerated beam and the rf field.

40981 **Simulation of the capture process in the Fermilab Booster.** Stahl, S.; Ankenbrandt, C. (Fermi National Accelerator Lab., Batavia, IL (US)). pp 1117-1119 of Proceedings of the 1987 IEEE particle accelerator conference: Accelerator engineering and technology. Lindstrom, E.R.; Taylor, L.S. Piscataway, NJ; IEEE Service Center (1987). (CONF-870302—).

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A progress report on efforts to understand and improve adiabatic capture in the Fermilab Booster by experiment and simulation is presented. In particular, a new Rf voltage program for capture which ameliorates transverse space-charge effects is described and simulated.

40982 **Study of misalignment effects in electron beam transport through a periodic solenoid channel.** Reiser, M.; McAdoo, J.; Low, K.; Kehne, D.; Shea, T. (Electrical Engineering Dept. and Lab. for Plasma and Fusion Energy Studies, Univ. of Maryland, College Park, MD (US)). pp 1135-1137 of Proceedings of the 1987 IEEE particle accelerator conference: Accelerator engineering and technology. Lindstrom, E.R.; Taylor, L.S. Piscataway, NJ; IEEE Service Center (1987). (CONF-870302—).

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

Recent studies on the Maryland 36-lens electron beam transport experiment had indicated that the fraction of beam transported and the emittance depended strongly on the alignment state of the channel. As a result, the channel lenses were realigned and an adjustment system was built for the electron gun. The authors report the first experimental results on beam transport through the realigned system. A major improvement in beam centering has been achieved resulting in 100% beam transmission for a wide range of lens magnetic field strengths. The emittance growth observed in this region is compared with simulation results.

40983 **Transient analysis of a coupled accelerator and decelerator system.** Takeda, H. (Los Alamos National Lab., Los Alamos, NM (US)). pp 1161-1163 of Proceedings of the 1987 IEEE particle accelerator conference: Accelerator engineering and technology. Lindstrom, E.R.; Taylor, L.S. Piscataway, NJ; IEEE Service Center (1987). (CONF-870302—).

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

For an energy-efficient accelerator system to be used for a free-electron laser, the stability of an energy-recovery system utilizing a bridge coupler placed between the accelerator and the decelerator is studied numerically. Energy is recovered by recirculating the accelerated electron beam through the decelerator; the recovered energy is then transported through the bridge coupler to the accelerator. The calculation shows that a large transient voltage oscillation is induced into the system. This transient oscillation can be reduced significantly by slowly applying both the electron-beam current and the klystron power at the beginning. Two types of instabilities are predicted according to the scraping of the electron beam between the accelerator and the decelerator. When the energy spectrum of the electron beam is scraped at the high end, the system induces an oscillation. However, when the low-energy end is scraped the electron recirculation may stop unless the klystron power is boosted by a feedback system.

40984 **Transmission-line impedance measurements of beam pipes for an Advanced Hadron Facility.** Walling, L.; Neuffer, D.; Thiessen, H.A.; Spalek, G. (Los Alamos National Lab., Los Alamos, NM (US)). pp 1164-1166 of Proceedings of the 1987 IEEE particle accelerator conference: Accelerator engineering and technology. Lindstrom, E.R.; Taylor, L.S. Piscataway, NJ; IEEE Service Center (1987). (CONF-870302—).

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An Advanced Hadron Facility (AHF) requires a beam pipe with low eddy-current losses and a low beam-coupling impedance. The requirements cannot be met with a solid, conducting beam pipe but may be met by a ceramic pipe with conducting layers, which may have a higher coupling impedance. We have measured and compared the transmission-line impedances for several candidate pipe segments. The results are correlated with the beam-coupling impedance and are compared with calculated values and with AHF requirements.

40985 **Beam transfer lines for the AGS booster.** Gupta, R.C.; Lee, S.Y.; Lee, Y.Y.; Zhao, X.F. (Accelerator Development Dept., Brookhaven National Lab., Upton, NY (US)). pp 1193-1195 of Proceedings of the 1987 IEEE particle accelerator conference: Accelerator engineering and technology. Lindstrom, E.R.; Taylor, L.S. Piscataway, NJ; IEEE Service Center (1987). (CONF-870302—).

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

The injection lines for the proton and heavy ion beam injection into the Booster and a beam transfer line from the Booster to the Alternating Gradient Synhrotron (AGS) are described here. The proton injection line is from the 200 MeV linac and the heavy ion injection line is from the present beam transport line of the Tandem Van de Graaf. The beam transfer line is for transporting the accelerated beam from the Booster to the AGS. Also included in the discussion is a method of extraction from the Booster and injection into the AGS.

40986 **A fast transition jump scheme at the Brookhaven AGS.** Yamin, P.; Ahrens, L.; Auerback, E.; Raka, E.; Ratner, L. (AGS Dept., Brookhaven National Lab., Upton, NY (US)). pp 1216-1217 of Proceedings of the 1987 IEEE particle accelerator conference: Accelerator engineering and technology. Lindstrom, E.R.; Taylor, L.S. Piscataway, NJ; IEEE Service Center (1987). (CONF-870302—).

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

An improvement plan is now underway which is designed to raise the intensity of the circulating beam in the AGS to 4×10^{13} protons. Part of the work involves minimizing losses at transition caused by the negative mass instability. The authors plan to use pulsed quadrupole doublets to speed up passage through transition. Existing magnets separated by 32 betatron wavelength appear adequate for the purpose. Computer modeling has been carried out, and this work is compared with experimental studies.

40987 **Particle longitudinal diffusion produced by a high frequency cavity.** Kats, J.M. (AGS Dept., Brookhaven National Lab., Associated Universities, Inc., Upton, NY (US)). pp 1281-1283 of Proceedings of the 1987 IEEE particle accelerator conference: Accelerator engineering and technology. Lindstrom, E.R.; Taylor, L.S. Piscataway, NJ; IEEE Service Center (1987). (CONF-870302—).

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A High Frequency Cavity (HFC) can be a powerful tool for the reduction of particle losses during the energy passage through the γ-transition in proton synchrotrons, via bunch dilution. In this paper, the authors consider some aspects of bunch dilution. With an appropriately chosen frequency of phase modulation, the HFC can produce parametric resonance for particles near the bunch center. As a result, the process of dilution can be accelerated.

40988 **The completed design of the SLC Final Focus System.** Murray, J.J.; Brown, K.L.; Fieguth, T. (Stanford Linear Accelerator Center, Stanford Univ., Stanford, CA (US)). pp 1331-1333 of Proceedings of the 1987 IEEE particle accelerator conference: Accelerator engineering and technology. Lindstrom, E.R.; Taylor, L.S. Piscataway, NJ; IEEE Service Center (1987). (CONF-870302—). Contract AC03-76SF00515.

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The design of the SLC Final Focus System has evolved from its initial conceptual design into its final form. This final design is described including a review of the critical decisions influencing the adoption of particular features. The creation of a feasible design has required that these decisions be tempered by practical considerations such as site constraints, correction of optical errors caused by imperfections, and accommodations requested by engineers and particle detector physicists. As this is the first such system to be built, it is hoped that the experience gained will be useful for the design of future systems.

40989 **Transverse wakefield control and feedback in the SLC LINAC.** Seeman, J.T.; Campisi, I.E.; Herrmannsfelds, W.; Lee, M.; Petersen, A.; Phinney, N.; Ross, M.; Stiening, R.; Thompson, K.; Tsang, D. (Stanford Linear Accelerator Center, Stanford, CA (US)). pp 1349-1352 of Proceedings of the 1987 IEEE particle accelerator conference: Accelerator engineering and technology. Lindstrom, E.R.; Taylor, L.S. Piscataway, NJ; IEEE Service Center (1987). (CONF-870302—). Contract AC03-76SF00515;AC03-76SF00098.

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

Transverse wakefields in the linac of the SLAC Linear Collider (SLC) have been observed to enlarge the effective emittance of beams which are not properly centered in the accelerating structure. A fast feedback system has been constructed to minimize the enlargement under changing conditions by controlling the beam launching parameters. Theoretical aspects of this transverse feedback system are reviewed as well as the design of the beam sensors, launch controllers, communication equipment and data processing micro-computer. A variety of beam observations have been made. They show that dispersion as well as wakefield effects are important. In the near future the fast transverse feedback system will be beam tested, and algorithms tailored to the noise environment of the SLC will be tried.

40990 **Operation of the ORNL ECR source.** Meyer, F.W.; Hale, J.W. (Oak Ridge National Lab., Oak Ridge, TN (US)). pp 319-321 of Proceedings of the 1987 IEEE particle accelerator conference: Accelerator engineering and technology. Lindstrom, E.R.; Taylor, L.S. Piscataway, NJ; IEEE Service Center (1987). (CONF-870302—).

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

The ORNL ECR multicharged ion source, dedicated for studying the atomic physics interactions of multicharged ions with atoms, ions, electrons, and surfaces has been in operation since 1984. High charge state ion beams ranging from fully stripped light ions (up to Ne) to up to 40% stripped heavy ions (A—200) have been produced. Ion beams of the metallic elements developed to date include Cr, Fe, Ni, Ta, and Au, and are obtained by the use of a solid feed technique.

40991 **Progress toward a milli-ampere nuclear polarized H^- source.** Hershcovitch, A.; Alessi, J.G.; De Vito, B.; Kponou, A.; Niinikoski, T. (AGS Dept., Brookhaven National Lab., Associated Universities, Inc., Upton, NY (US)). pp 328-330 of Proceedings of the 1987 IEEE particle accelerator conference: Accelerator engineering and technology. Lindstrom, E.R.; Taylor, L.S. Piscataway, NJ; IEEE Service Center (1987). (CONF-870302—).

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

A new polarized H^- source producing currents at the milli-Ampere level was designed and is presently being assembled at BNL. This source is composed of three novel elements which have

been developed separately. A cold atomic beam yielded H^0 fluxes as high as 9.4 x 10^{16} and 4 x 10^{19} atomss-sr at accommodator temperatures of 5.8 K and 26 K respectively. A superconducting solenoid for spin selection designed to have an acceptance angle of 0.1 sr for this atomic beam was developed. A ring magnetron ionizer, which converts H^0 to H^- by charge exchange with 200 eV D^-, yielded 500 μA of H^- for an estimated H^0 density of 10^{13} cm^{-3}. A successful matching and assembling of these elements should result in a milli-Ampere polarized H^- source.

40992 **Status of the MEVVA high current metal ion source.** Brown, I.G.; Galvin, J.E.; MacGill, R.A.; Wright, R.T. (Lawrence Berkeley Lab., Univ. of California, Berkeley, CA (US)). pp 343-345 of Proceedings of the 1987 IEEE particle accelerator conference: Accelerator engineering and technology. Lindstrom, E.R.; Taylor, L.S. Piscataway, NJ; IEEE Service Center (1987). (CONF-870302—). Contract AC03-76SF00098.

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The MEVVA (Metal Vapor Vacuum Arc) ion source that has been developed at LBL was reported on for the first time at the 1985 Particle Accelerator Conference. This source can produce hundreds of milliamperes of beam current of metal species from lithium up to uranium. In the period since then the authors have developed the source further, and this work is summarized here. The authors have now run the source with over 30 different beam species, and with an extraction voltage up to 110 kV. They have made and operated a miniature source, the MicroMEVVA. A multi-cathode version, in which one can switch rapidly between cathodes of different materials, has recently been constructed and tested. Applications of the source include: as a synchrotron ion source, as an ion source for heavy ion fusion, and for metallurgical ion implantation; they have done some preliminary work in these directions.

40993 **H^- ion source with high duty factor.** Smith, H.V. Jr.; Schnurr, N.M.; Whitaker, D.H.; Kalash, K.E. (Los Alamos National Lab., Los Alamos, NM (US)). pp 301-303 of Proceedings of the 1987 IEEE particle accelerator conference: Accelerator engineering and technology. Lindstrom, E.R.; Taylor, L.S. Piscataway, NJ; IEEE Service Center (1987). (CONF-870302—).

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

The small-angle source (SAS) and 4X source are Penning surface-plasma sources (SPS) that produce high-brightness H^- ion beams for accelerator applications. However, electrode cooling considerations have limited the duty factor for pulsed operation to 1-3% and the maximum cw H^- beam to 2-4 mA. The addition of some active cooling to the 4X source has allowed pulsed operation at 6% duty factor for arc parameters sufficient to produce — 100mA of H^- beam. More vigorous cooling, now being added, should allow production of cw H^- beams up to 20-40 mA. The cooled electrodes were designed using the predictions of TOPAZ2D, a 2-D transient, conductive heat-transfer code. The latest results, along with the possibility of producing even larger cw H^- beam currents, are discussed.

40994 **Performance of the 5 MeV injector for the NBS-Los Alamos racetrack microtron.** Wilson, M.A.; Ayres, R.L.; Cutler, R.I.; Debenham, P.H.; Lindstrom, E.R.; Mohr, D.L.; Penner, S.; Rose, J.; Young, L.M.; Stovall, J. (National Bureau of Standards, Gaithersburg, MD (US)). pp 322-324 of Proceedings of the 1987 IEEE particle accelerator conference: Accelerator engineering and technology. Lindstrom, E.R.; Taylor, L.S. Piscataway, NJ; IEEE Service Center (1987). (CONF-870302—).

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The NBS-Los Alamos racetrack microtron (RTM) injector consists of a 100 keV chopperbuncher system and a 5 MeV, 2-section, side-coupled, continuous wave RF linace operating in a standing-wave mode at 2380 MHz. The purpose of the injector is to provide a low-emittance electron beam of up to 550 μA CW current, with a suitably small phase and energy spread for insertion into the RTM. Measurements have been made of the injector beam energy, energy spread, and transverse emittance over a range of beam current from 150 μA to 600 μA and at beam energies of 4.08 MeV, and 5.50 MeV. The measured, normalized, transverse emittance, averaged over beam current and energy is $\epsilon/sub\ nx/ = 0.55$ mm-mrd and $\epsilon/sub\ ny/ = 0.71$ mm-mrad. These results indicate a beam quality considerably better than the design goal of 5.0 mm-mrad. The measured beam energy spread, ΔE, is 5 keV at 5 MeV and appears relatively independent of beam current. Although measurements of the beam phase spread are incomplete, preliminary results suggest the longitudinal emittance is no greater than 5 keV-degrees, which is well within the design goal of 20 keV-degrees.

40995 **RFQ accelerators for heating thermonuclear plasmas.** Stokes, R.H.; Wangler, T.P.; Crandall, K.R. (Los Alamos National Lab., Los Alamos, NM (US)). pp 334-336 of Proceedings of the 1987 IEEE particle accelerator conference: Accelerator engineering and technology. Lindstrom, E.R.; Taylor, L.S. Piscataway, NJ; IEEE Service Center (1987). (CONF-870302—).

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The radio-frequency quadrupole (RFQ) accelerator has been developed to generate high-current ion beams for a wide variety of applications. It has also been suggested that this type of accelerator could be used to produce megawatt in beams to heat thermonuclear reactor plasmas. For a tokamak reactor, an RFQ accelerator can be designed to provide negative deuterium ions that are neutralized before injection through the tokamak magnetic field. Also, it may be possible to use singley charged, positive, heavier ions that traverse the magnetic field with minimal deflection and then become multiply ionized upon striking the tokamak plasma. The authors present preliminary RFQ beam-dynamics designs for both deuterium and oxygen ions.

40996 **Simple laser-driven, metal photocathodes as cold, high-current electron sources.** Saunders, J.D.; Ringler, T.J.; Builta, L.A.; Kauppila, T.J.; Moir, D.C.; Downey, S.W. (Naval Postgraduate School, Monterey, CA (US)). pp 337-339 of Proceedings of the 1987 IEEE particle accelerator conference: Accelerator engineering and technology. Lindstrom, E.R.; Taylor, L.S. Piscataway, NJ; IEEE Service Center (1987). (CONF-870302—).

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Recent developments in excimer laser design have made near ultraviolet light intensities of several $MWcm^2$ possible in unfocused beams. These advances and recent experiments indicate that high-current, simple-metal photoemissive electron guns are now feasible. Producing more than 50 Acm^2 of illuminated cathode surface, the guns could operate at vacuums of 10^{-6} torr with no complicated system components inside the vacuum enclosure. The electron beam produced by such photoemission guns would have very low emittance and high brightness. This beam would also closely follow the temporal characteristics of the laser pulse, making fast risetime, ultrashort electron beam pulses possible.

40997 **H^- source and beam transport experiments for a new RFQ.** Alessi, J.G.; Brennan, J.M.; Kponou, A.H.; Prelec, K. (Brookhaven National Lab., Upton, NY (US)). pp 304-306 of Proceedings of the 1987 IEEE particle accelerator conference: Accelerator engineering and technology. Lindstrom, E.R.; Taylor, L.S. Piscataway, NJ; IEEE Service Center (1987). (CONF-870302—).

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A new RFQ preinjector is being built for the 200 MeV Linac at the AGS. For injection into this RFQ, a symmetric emittance has been obtained from a circular aperture magnetron H^- source. Transport studies are beginning to address possible problems with space charge or instabilities in the 35 keV line. A volume H^- source is being tested as an eventual replacement for the magnetron.

40998 **Design of a 200 mA dc h^- injector for an RFQ.** Anderson, O.A.; Chan, C.F.; Cooper, W.S.; Kunkel, W.B.; Kwan, J.W.; Lietzke, A.F.; Matuk, C.A.; Purgalis, P.; Soroka, L. (Lawrence Berkeley Lab., Univ. of California, Berkeley, CA (US)). pp 289-291 of Proceedings of the 1987 IEEE particle accelerator conference: Accelerator engineering and technology. Lindstrom, E.R.; Taylor, L.S. Piscataway, NJ; IEEE Service Center (1987). (CONF-870302—). Contract AC03-76SF00098.

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The authors discuss the design of a high-current DC H^- injector system. A few of the system features are: (1) a carefully designed electron trap in the accelerator which does not produce appreciable aberrations in the H^- beam, (2) open accelerating and transport structures which allow a high rate of gas pressure reduction, and (3) exclusive use of electrostatic focusing in the transport section which prevents plasma buildup and eliminates possible emittance growth from plasma fluctuations.

40999 **AGS preinjector improvement.** Alessi, J.G.; Brennan, J.M.; Brown, H.N.; Brodowski, J.; Gough, R.; Kponou, A.; Prelec, K.; Staples, J.; Tanabe, J.; Witkover, R. (AGS Dept., Brookhaven National Lab., Upton, NY (US)). pp 276-278 of Proceedings of the 1987 IEEE particle accelerator conference: Accelerator engineering and technology. Lindstrom, E.R.; Taylor, L.S. Piscataway, NJ; IEEE Service Center (1987). (CONF-870302—).

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In 1984, a polarized H^- source was installed to permit the acceleration of polarized protons in the AGS, using a low current, 750 keV RFQ Linear Accelerator as the preinjector. This RFQ was designed by LANL [1] and has proved to be quite satisfactory and reliable. In order to improve the reliability and simplify maintenance of the overall AGS operations, it has been decided to replace one of the two 750 keV Cockcroft-Waltons (C-W) with an RFQ. The design of a new high current RFQ has been carried out by LBL [2] and is also being constructed there. This paper describes the preinjector improvement project, centered around that RFQ, which is underway at BNL.

41000 **A pulsed electron injector using a metal photocathode irradiated by an excimer laser.** Kauppila, T.J.; Builta, L.A.; Crutcher, J.K.; Elliott, J.C.; Moir, D.C. (Los Alamos National Lab., Los Alamos, NM (US)). pp 273-275 of Proceedings of the 1987 IEEE particle accelerator conference: Accelerator engineering and technology. Lindstrom, E.R.; Taylor, L.S. Piscataway, NJ; IEEE Service Center (1987). (CONF-870302—). Contract W-7405-ENG-36.

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The hot cathode of an electron gun is replaced by a metallic photocathode driven by an excimer laser. The current, current density, and emittance of the 500-kV electron beam produced by the photoelectron source are presented. In addition, the temperature of the photocathode is varied to study the possibility of a hybrid source.

41001 **Perturbation effects in the CEBAF beam transport system.** Douglas, D.R.; York, R.C. (CEBAF, 12070 Jefferson Avenue, Newport News, VA (US)). pp 1295-1297 of Proceedings of the 1987 IEEE particle accelerator conference: Accelerator engineering and technology. Lindstrom, E.R.; Taylor, L.S. Piscataway, NJ; IEEE Service Center (1987). (CONF-870302—).

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

The CEBAF accelerator design is a recirculating, superconducting, cw, electron linac producing beams with energies of 0.5 to 4.0 GeV. The lattice design of this machine is described elsewhere. Here, the authors discuss the machine chromatic correction scheme and the anticipated machine performance in the presence of synchrotron radiation excitation, optical perturbances such as misalignments, mispowerings, and magnet inhomogeneities, and errors in the extraction process.

41002 **The superhilac heavy ion intensity upgrade.** Feinberg, B.; Brown, I.G. (Lawrence Berkeley Lab., Univ. of California, Berkeley, CA (US)). pp 860-862 of Proceedings of the 1987 IEEE particle accelerator conference: Accelerator engineering and technology. Lindstrom, E.R.; Taylor, L.S. Piscataway, NJ; IEEE Service Center (1987). (CONF-870302—).

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A high current MEtal Vapor Vaccum Arc (MEVVA) ion source is to be installed in the third injector (Abel) at the SuperHILAC, representing the first accelerator use of this novel ion source. The MEVVA source has produced over 1 A of uranium in all charge states, with more than 100 electrical mA (emA) of U/sup 5+/. Transport of the space-charge dominated beam through the charge-state analysis dipole will be enhanced by a 100 kV extractor voltage and neutralization by secondary electrons. In addition to the MEVVA source, other improvements already in place include a lower pressure in the Low Energy Beam Transport line (15.8 keV/AMU) to reduce charge exchange for the heavy elements, and the addition of a second 23 MHz buncher upstream of the Wideroe linac and two 70 MHz bunchers between the 213 MHz Wideroe and the 70 MHz Alvarez linacs. The project is expected to result in a fivefold increase in beam delivered to Bevatron experiments, increasing the extracted uranium beam to 5x10/sup 7/ ions/pulse.

41003 **Injection and accumulation schemes for the AGS booster.** Lee, Y.Y. (Accelerator Development Dept., Brookhaven National Lab., Upton, NY (US)). pp 870-872 of Proceedings of the 1987 IEEE particle accelerator conference: Accelerator engineering and technology. Lindstrom, E.R.; Taylor, L.S. Piscataway, NJ; IEEE Service Center (1987). (CONF-870302—).

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The AGS Booster now under construction has three objectives. They are to increase the space charge limit of the AGS by preaccelerating protons from 200 MeV to 1.5 GeV, to increase the intensity of the polarized protons in the AGS by accumulating many linac pulses at 200 MeV, and to preaccelerate heavy ions from the BNL Tandem Van de Graaf before injection into the AGS. Therefore, one has to devise a different injection method for each of these three operations. The proton and polarized proton injection employs charge exchange of negative hydrogen while heavy ions must use multiturn injection into the betatron space. In this note the authors give a brief description of the heavy ion injection and high intensity proton injection, which are conventional and familiar to the reader, and describe the method of accumulating polarized protons in some detail.

41004 **The AGS-booster lattice.** Lee, Y.Y.; Barton, D.S.; Claus, J.; Cottingham, J.G.; Courant, E.D.; Danby, G.T.; Dell, G.F.; Forsyth, E.B.; Gupta, R.C.; Kats, J. (Accelerator Development Dept., Brookhaven National Lab., Upton, NY (US)). pp 865-866 of Proceedings of the 1987 IEEE particle accelerator conference: Accelerator engineering and technology. Lindstrom, E.R.; Taylor, L.S. Piscataway, NJ; IEEE Service Center (1987). (CONF-870302—).

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The interests of both particle and nuclear physicists are converging on the AGS; this machine is almost ideally and uniquely suited to perform a new class of frontier experiments. Particle physicists would like to study the extremely heavy (multi-TeV) particles posited by new theories by searching for rare K-decays. Nuclear physicists want to create the extremely dense form of nuclear matter which exists within neutron stars by studying heavy ion collisions. Particle physicists interested in spin physics would like to study polarized proton scattering in the very high momentum transfer region, which requires a higher intensity polarized proton flux. The ability of the AGS to simultaneously fulfill all these requirements can be addressed by the construction of a Booster synchrotron. With the addition of the Booster, the enhanced AGS will possess capabilities not available anywhere else in the world. The AGS Booster has three objectives. They are to increase the space charge limit of the AGS, to increase the intensity of the polarized proton

beam by accumulating many linac pulses (since the intensity is limited by the polarized ion source), and to reaccelerate heavy ions from the BNL Tandem Van de Graaff before injection into the AGS. The machine is capable of accelerating protons at 7.5 Hertz from 200 MeV to 1.5 GeV or to lower final energies at faster repetition rates. The machine will also be able to accelerate heavy ions from as low as 1 MeV/nucleon to a magnetic rigidity as high as 17.6 Tesla-meters with a one second repetition rate. As an accumulator for polarized protons, the booster should be able to store the protons at 200 MeV for several seconds. The construction project started in FY 1985 and is expected to be completed in 1989. The purpose of this paper is to provide a future reference for the AGS Booster.

41005 **The LBL multiple beam experiments.** Fessenden, T.J.; Keefe, D.; Kim, C.; Meuth, H.; Warwick, A. (Lawrence Berkeley Lab., Univ. of California, Berkeley, CA (US)). pp 898-902 of Proceedings of the 1987 IEEE particle accelerator conference: Accelerator engineering and technology. Lindstrom, E.R.; Taylor, L.S. Piscataway, NJ; IEEE Service Center (1987). (CONF-870302—).

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The multiple-beam induction linac approach to a heavy ion driver for inertial confinement fusion features continuous current amplification along the accelerator and a minimum of beam manipulations from source to pellet. Current amplification and bunch length control require careful shaping of the accelerating voltages. MBE-4 is designed as a four-beam induction linac that models much of the accelerator physics of the electrostatically focused section of a significantly longer induction accelerator. Four space-charge-dominated Cs/sup +/ beams, initially about one meter in length at a current of 13mA, are focused by electrostatic quadrupoles and accelerated in parallel from 200 to nearly 600 keV. The energy will reach approximately one MeV when the accelerator is complete. Experiments have proceeded in parallel with the construction of the apparatus which began in FY 85 and is now more that half complete. The results show a current amplification, so far, by a factor of 2.8 in good agreement with the longitudinal acceleration calculations.

41006 **Overview of high intensity x-ray and gamma-ray sources.** Prestwich, K.R.; Lee, J.R.; Ramirez, J.J.; Sanford, T.W.L.; Agee, F.J.; Frazier, G.B.; Miller, A.R. (Sandia National Labs., Albuquerque, NM (US)). pp 892-897 of Proceedings of the 1987 IEEE particle accelerator conference: Accelerator engineering and technology. Lindstrom, E.R.; Taylor, L.S. Piscataway, NJ; IEEE Service Center (1987). (CONF-870302—).

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

The requirements for intense x-ray and gamma-ray sources to simulate the radiation effects from nuclear weapons has led to the development of several types of terawatt-pulsed power systems. One example of a major gamma-ray source is Aurora, a 10-MV, 1.6-MA, 120-ns four-module, electron-beam generator. Recent requirements to improve the dose rate has led to the Aurora upgrade program and to the development of the 20-MV, 800-kA, 40-ns Hermes-III electron-beam accelerator. The Aurora program includes improvements to the pulsed power system and research on techniques to improve the pulse shape of the electron beam. Hermes III will feature twenty 1-MV, 800-kA induction accelerator cavities supplying energy to a magnetically insulated transmission line adder. Hermes III will become operational in 1988. Intense x-ray sources consist of pulsed power systems that operate with 1-MV to 2-MV output voltages and up to 25-TW output powers. These high powers are achieved with either low impedance electron-beam generators or multimodular pulsed power systems. The low-impedance generators have high voltage Marx generators that store the energy and then sequentially transfer this energy to pulse-forming transmission lines with lower and lower impedance until the high currents are reached. In the multimodule machines, each module produces 0.7-TW to 4-TW output pulses, and all of the modules are connected together to supply energy to a single diode.

41007 **Electron collector and ion species experiments on the LION extractor ion diode.** Rondeau, G.; Greenly, J.B.; Hammer, D.A.; Horioka, K.; Meyerhofer, D.D. (Lab. of Plasma Studies, Cornell Univ., Ithaca, NY (US)). pp 99 of The 1987 IEEE international conference on plasma science (Abstracts). Piscataway, NJ; IEEE Service Center (1987). (CONF-870651—).

From IEEE international conference on plasma science; Crystal City, VA, USA (1 Jun 1987).

Studies of the effects of an electron collector on the electron flow in an ion diode and on diode impedance history are being done with an extractor geometry ion diode (B/sub r/ magnetic insulation field) on the LION accelerator (1.5 MV, 4Ω, 40 ns). The collector is a flux-penetrable metal protrusion on the inner radius of the anode that collects electrons. This device increases the diode operating impedance particularly during the later part of the pulse when the diode impedance collapses without the collector. In the present set of experiments, several thin wires are inserted into the anode and allowed to protrude a few millimeters into the A-K gap. These wires are damaged by the electron flow during the pulse and by measuring the length of the remaining wire, the distance of the electron layer from the anode can be inferred. The ion current density is also measured in three radial locations across the diode, giving a measure, through the Child-Langmuir law, of the effective gap spacing between the anode and the electron sheath. A simple model is proposed to account for the scaling of ion current density with the diode voltage observed in the experiment.

41008 **Impedance characteristics of the Bz diode on the LION accelerator.** Meyerhofer, D.D.; Horioka, K.; Kusse, B.; Rondeau, G.; Struckman, C. (Lab. of Plasma Studies, Cornell Univ., Ithaca, NY (US)). pp 99 of The 1987 IEEE international conference on plasma science (Abstracts). Piscataway, NJ; IEEE Service Center (1987). (CONF-870651—).

From IEEE international conference on plasma science; Crystal City, VA, USA (1 Jun 1987).

The LION accelerator at Cornell University is being used to study the characteristics of the applied B/sub z/, or 'barrel' diode. This 0.8 TW, 4 ohm, ion accelerator has the ability to take several shots per day, and hence alloys systematic scans to be performed. An important result of a recent series of experiments is that the diode impedance remains relatively constant, decaying only slowly, during the 50 nsec pulse. When the diode is operated with a 4.5 mm gap and a 21 kG insulating magnetic field, the typical diode parameters, are a voltage of 1 MV and a total current of 250 kA, leading to a diode impedance of 4 ohms and power of 0.25 TW. The diode impedance decays with a 100 nsec time constant. The ion beams have peak currents of roughly 125 kA and typical impedances of Bohms, which decays with a time constant of 25 nsec. The Child-Langmuir gap was approximately 2 mm and closed with a velocity of roughly 2X10/sup 6/ cm/sec. Current experimental work is aimed at characterizing the impedance of the B/sub z/ diode as a function of the applied magnetic field, the A-K gap, the anode curvature, and the anode groove parameters. In addition, the effect of changing the voltage rise with a plasma opening switch and of adding an electron limiter is examined. The ion beam quality is examined at the focus of the barrel diode with a swept Thomson parabola and various Rutherford scattering diagnostics.

41009 **Status of ECR source technology.** Lyneis, C.M. (Lawrence Berkeley Lab., 1 Cyclotron Road, Berkeley, CA (US)). pp 254-258 of Proceedings of the 1987 IEEE particle accelerator conference: Accelerator engineering and technology. Lindstrom, E.R.; Taylor, L.S. Piscataway, NJ; IEEE Service Center (1987). (CONF-870302—).

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

ECR (Electron Cyclotron Resonance) ion sources are now in widespread use for the production of high quality multiply charged ion beams for accelerators and atomic physics experiments, and industrial applications are being explored. In the last decade ECR sources have evolved from a single larger, power consuming, complex prototype (SUPERMAFIOS) into a variety of compact, simple, reliable, efficient, high charge state ions. Eight laboratories have one or more ECR sources in regular operation with cyclo-

trons. At least seven other ECR sources are under development or in the planning stage for use with cyclotrons. An ECR source supplied an O/sup 6+/ beam to the CERN SPS accelerator where it was stripped to the O/sup 8+/ and accelerated to 200 GeV/μ. A project is underway at Argonne to couple an ECR source to a superconducting heavy-ion linac. Four ECR sources are in dedicated use for atomic physics and three of the ECR sources coupled to cyclotrons are also used for low energy atomic physics research. Polarized ion sources are being developed, which employ ECR discharges to ionize the beams. A very high efficiency ECR ion source is being developed for the purification of medical radioisotopes.

41010 **Interaction of a rotating proton beam with a magnetized plasma.** Schamiloglu, E.; Greenly, J.B.; Hammer, D.A. (Lab. of Plasma Studies, Cornell Univ., Ithaca, NY (US)). pp 98-99 of The 1987 IEEE international conference on plasma science (Abstracts). Piscataway, NJ; IEEE Service Center (1987). (CONF-870651—).

From IEEE international conference on plasma science; Crystal City, VA, USA (1 Jun 1987).

An annular proton beam is injected into a preionized magnetically confined hydrogen plasma and the response of the plasma and the beam to the interaction are investigated. The proton beam is generated by a plasma-anode magnetically insulated diode coupled to the LONGSHOT II generator. Typically, average proton current densities of 40-60 A/cm/sup 2/ at energies of 60-160 keV are extracted over the 1 μs voltage pulse length. The impedance of the diode is controlled by the position of the anode plasma front when the generator voltage pulse arrives at the diode. This annular beam is injected across a cusp-like magnetic field into a preionized hydrogen plasma afterglow in a $\geqq$ 5.5 kG solenoidal field. The plasma is produced by a z-discharge between hollow electrodes 250 cm apart in a puffed H/sub 2/ fill of 10 mTorr. The resultant plasma has n/sub rho/ $\cong$ 3 x 1-/sup 14//cm/sup 3/m T/sub e/ $\cong$ 2 eV and is confined to the outer region of the 30 cm diameter pyrex discharge tube.

41011 **Brightness and coherence of radiation from undulators and high-gain free electron lasers.** Kim, K.J. (Lawrence Berkeley Lab., Univ. of California, Berkeley, CA (US)). pp 194-198 of Proceedings of the 1987 IEEE particle accelerator conference: Accelerator engineering and technology. Lindstrom, E.R.; Taylor, L.S. Piscataway, NJ; IEEE Service Center (1987). (CONF-870302—).

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

Undulators in next-generation, low-emittance electron storage rings are sources of extremely bright radiation in wide range of spectral region covering photon energies between several eV to several tens of keV. The expected brightness is several times 10/sup 19/ photons per second per (mm-rad)/sup 2/ per 0.1% bandwidth. Furthermore, the undulator radiation from storage rings of moderate energies, between 1 to 2 GeV, will have substantial coherence properties in the vacuum ultraviolet and the soft x-ray regions, generating tens of miliwatts of time-averaged coherent power of 1-micron coherence length. At the same time, free-electron lasers (FELs), which have been so far limited to the infrared and visible wavelengths, will eventually be developed to generate even more intense and coherent radiation for the vacuum ultraviolet and shorter wavelengths. Among different FEL schemes, the so-called high-gain FELs are conceptually the most straightforward extension of the undulator techniques, the transition to high-gain FELs occurring simply with better electron beam qualities and longer undulators. High-gain FELs can produce tens of megawatts of peak coherent power at wavelengths shorter than 1000 A. With these in mind, the purpose of this paper is to review the radiation characteristics of undulators and high-gain FELs.

41012 **Brightness of an intense electron beam generated by a pulse-laser irradiated photocathode.** Oettinger, P.E.; Bursuc, I.; Shefer, R.E.; Pugh, E. (Thermo Electron Corp., 85 First Avenue, Waltham, MA (US)). pp 286-288 of Proceedings of the 1987 IEEE particle accelerator conference: Accelerator engineering and technology. Lindstrom, E.R.; Taylor, L.S. Piscataway, NJ; IEEE Service Center (1987). (CONF-870302—).

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

Linac-driven free electron lasers, new powerful synchrotron radiation sources, and advanced high-power microwave devices all require very bright emitters of electrons to operate efficiently. By irradiating a Cs/sub 3/Sb photocathode with a frequency-doubled Nd:glass laser, the authors obtained a very high normalized electron beam brightness of over 10/sup 11/ A/m/sup 2//rad/sup 2/. Peak currents emitted from the 1-cm/sup 2/ surface in 50-ns pulses ranged up to 80 A. Measured normalized emittences were between 50 and 9 π-mm-mrad. The efficient transfer of beam energy into the radiative field of free electron lasers, synchrotron sources, and powerful microwave tubes requires electron beams of very high brightness. This paper presents experimental data on the high brightness achievable from photoemitted beams generated by pulse-laser-irradiating a cesium antimonide (Cs/sub 3/Sb) surface.

41013 **Pulsers for the induction linac experiment, MBE-4.** Gough, D.; Brodzik, D.; Faltens, A.; Pike, C.; Stoker, J. (Lawrence Berkeley Lab., Univ. of California, Berkeley, CA (US)). pp 954-956 of Proceedings of the 1987 IEEE particle accelerator conference: Accelerator engineering and technology. Lindstrom, E.R.; Taylor, L.S. Piscataway, NJ; IEEE Service Center (1987). (CONF-870302—).

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

The MBE-4 proof-of-principle experiment uses an induction linac to accelerate four Cs+ beams from injection at 200 kV to almost 1MV. When completed in the summer of 1987 it will be 17.2 meters long and have 24 acceleration gaps and 6 diagnostic gaps. Careful tailoring of the accelerating voltage waveforms at each gap is required to accelerate the beam, amplify the current and provide longitudinal focusing. The ideal voltage waveforms required at the first 4 gaps are almost triangular with an amplitude of about 20 kV and an approximate width of 3 μsec, becoming flatter and shorter with an amplitude of 30 kV at subsequent gaps as the beam current increases and the pulse width narrows. Pulser voltage waveforms at each gap are adjusted in both amplitude and firing time in conjunction with beam experiments to determine the required voltage waveforms of the subsequent pulsers. Existing cores and previous experience with thyratron pulsers provided the basis for the pulsers for the first half of the machine. During this fabrication period, additional cores and spark gap pulsers capable of generating higher voltages than the thyratron pulsers became available and a combination of both types of pulser will be used to complete the apparatus.

41014 **Use of permanent magnets in accelerator technology: Present and future.** Halbach, K. (Center for X-Ray Optics, Lawrence Berkeley Lab., Berkeley, CA (US)). pp 259-278 of High performance permanent magnet materials. Sankar, S.G.; Herbst, J.F.; Koon, N.C. Pittsburgh, PA; Materials Research Society (1987). (CONF-8704243—).

From High performance permanent magnet materials; Anaheim, CA, USA (23 Apr 1987).

Permanent magnet systems have some generic properties that, under some circumstances, make them not only mildy preferable over electromagnets, but make it possible to do things that can not be done with any other technology. After a general discussion of these generic advantages, some specific permanent magnet systems will be described. Special emphasis will be placed on systems that have now, or are likely to have in the future, a significant impact on how some materials research is conducted.

41015 **Beam quality of the ATA injector.** Boyd, J.K.; Caporaso, G.J.; Cole, A.G.; Weir, J.T. (Lawrence Livermore National Lab., P.O. Box 808, Livermore, CA (US)). pp 925-927 of Proceedings of the 1987 IEEE particle accelerator conference: Accelerator engineering and technology. Lindstrom, E.R.; Taylor, L.S. Piscataway, NJ; IEEE Service Center (1987). (CONF-870302—).

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

The beam quality of the ATA injector has been experimentally measured using a magnetic collimator. These measurements have been performed for a variety of magnetic field profiles, in-

cluding field strengths where the collimator is shorter than a cyclotron wavelength. The experimental currents transmitted through the collimator have been predicted numerically. The numerical predictions and experimental data are in good agreement.

4304 Storage Rings

REFER ALSO TO CITATION(S) 40832, 40833, 40837, 40841, 40935

41016 **(BNL—41280) Automatic beam steering in the NSLS [National Synchrotron Light Source] storage rings using closed orbit feedback.** Nawrocky, R.J.; Bittner, J.W.; Ma, Li; Rarback, H.M.; Siddons, D.P.; Yu, L.H. (Brookhaven National Lab., Upton, NY (USA)). 1987. Contract AC02-76CH00016. 7p. (CONF-870610—25). Unlimited audience, publicly available. Elsevier Science Publisher, 52 Vanderbilt Ave., New York, NY 10017;1. Order Number TI88011516/JAW.

From 5. national synchrotron radiation instrumentation conference; Madison, WI, USA (21 Jun 1987).

This paper describes recent work on beam stabilization systems for the NSLS electron storage rings. It also reviews several types of detectors presently available for monitoring beam motion and describes possible schemes for stablizing photon beams in a storage ring. Finally, it briefly discusses plans for simultaneous stabilization of many beam lines in the storage rings.

41017 **(IFVE-OUNK—87-32) Studying the characteristics of quickly released flance coupling for vacuum system elements.** Gubrienko, K.I.; Kochetov, V.V.; Larionov, A.V. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1987. 7p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88703197/JAW.

There are several dozens of thousands of superhigh vacuum metal flange couplings in the vacuum system of the IHEP acceleration and storage complex. For mounting and operation convenience the most part of these couplings are quickly released ones. Sealing force dependence on the roughness of the flange sealing surfaces and their treatment method as well as on the material of gaskets and their fabrication technology, is determined for metal quickly released couplings of vacuum system elements. A possibility of the gasket repeated application is ascertained. 2 refs.; 2 figs.

41018 **(IFVE-OUNK—87-65) Electric strength of transposed cable for the UNK model magnets.** Kozub, S.S. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1987. 12p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703198/JAW.

Device and methods for investigating the electric strength of the UNK model magnet transposed cable insulation are described. Results of investigation into electric strength of various types of insulation coatig of transposed cable in the air and helium at indoor temperature, as well as in liquid helium, are presented. The model magnet current-carryng element is a plane cable, transposed from 23 SKNT-0.85-2970-0.42 wires. The cable cross section has a trapezoid-like shape, its height being 10.55 mm and basement width - 1.34 and 1.68 mm. The cable was insulated by applying spiral winding of lavsan or polyimide film tape with the thickness of 20 μm and applying 100 μm thickness glass tape, impregnated with nonpolymerized epoxy resin EhD-16, or 40 μm thickness polyimide film with bilateral adhesive coating above that tape. The insulation tape width was 10 mm. The cable turns in a ready magnet are compressed by 50-80 MPa pressure. It is ascertained, that polyimide film base coating is the most reliable. Since the cable insulation break down voltage depends on the environment, the electric strength of liquid helium, gaseous helium at different temperatures and air at indoor temperatures in gaps, comparable with the insulation thickness, is investigated. 8 refs.; 4 figs.; 1 tab.

41019 (KEK—87-13, pp 16-24) **Radio frequency source for electron storage ring in photon factory. History and current status.** Kobayakawa, Hisashi. (National Lab. for High Energy Physics, Oho, Ibaraki (Japan)). Sep 1987. (In Japanese). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88780097/JAW. (CONF-8706325—).

From Meeting on high-power, high-frequency power sources; Oho, Japan (4 Jun 1987).

The electron storage ring in the KEK Photon Factory (PF) has been in operation with an energy of 2.5 GeV and storage current of 300 mA. Two large-output klystrons (180 kW cW) are in place to supply electric power for radio frequency acceleration in the PF ring. Troubles with these klystrons became noticeable about six months after the start of the operation of the PF ring in 1982. Persistent efforts were made to improve the klystrons, making great contributions to the current successful operation of the PF. The structure of the PF ring and major parameters related to the radio frequency system are described. The performance of the 180 kW UHF klystron and that of an acceleration cavity are also given. The quantum lifetime is calculated at two days, and the power in the cavity is obserVed consinuously to confirm that this Pc is kept constant regardless of the current. Leak from a klystron started to occur frequently in August of 1982. These leak troubles were attributed to corrosion at a welded portion of the inner tube SUS 304. In another case, a decrease in gain was caused by copper, etc., sputtered onto a ceramic cavity wall. (Nogami, K.).

41020 **(SLAC-PUB—4646) Rf power sources.** Allen, M.A. (Stanford Linear Accelerator Center, Menlo Park, CA (USA)). May 1988. Contract AC03-76SF00515. 5p. (CONF-880695—16). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88012741/JAW.

From 1. European particle accelerator conference; Rome, Italy (7 Jun 1988).

This paper covers RF power sources for accelerator applications. The approach has been with particular customers in mind. These customers are high energy physicists who use accelerators as experimental tools in the study of the nucleus of the atom, and synchrotron light sources derived from electron or positron storage rings. This paper is confined to electron-positron linear accelerators since the RF sources have always defined what is possible to achieve with these accelerators. 11 refs., 13 figs.

41021 **Relativistic heavy ion collider project at Brookhaven.** Reardon, P.J. (Brookhaven National Lab., Upton, NY (USA)). *Nuclear Physics [Section] A;* **478**: vp(Feb-Mar 1988). (CONF-870413—). Contract AC02-76CH00016.

From 11. international conference on particles and nuclei; Kyoto, Japan (20 Apr 1987).

Also published as report BNL--40007; CONF-870413--7.

The Relativistic Heavy Ion Collider (RHIC) facility will provide collision energies of 100 GeV/nucleon per beam for heavy ions as massive as gold. RHIC will use the existing Brookhaven AGS and Tandem Van de Graaff as injector. The new accelerator facility, which is a nuclear physics initiative, will utilize the existing facilities of the partially completed CBA project. This report discusses the physics motivation for such a facility, the status of the machine design, R and D work and preparation for experiments at RHIC.

41022 **Modeling of proximity coupling between superconducting filaments in superconducting dipole magnets.** Green, M.A. (Lawrence Berkeley Lab., CA (USA)). pp 149-157 of Advances in cryogenic engineering. Volume 33. Fast, R.W. (ed.). New York, NY; Plenum Press (1988). (CONF-8706125—). Contract AC03-76SF00098.

From Cryogenic engineering conference; St. Charles, IL, USA (14 Jun 1987).

There is experimental evidence for superconducting current coupling in the fine multifilamentary Nb-Ti proposed for the SSC. The coupling appears to be Type II superconducting. As a result the AC loss and magnetization can increase as filament size is reduced. A computer model is presented which fits experimental data for proximity coupling between filaments in a superconducting matrix. The model predicts the effect of proximity coupling on the field uniformity of SSC dipole magnets.

41023 SSC magnet cryostat suspension system design. Nicol, T.H.; Niemann, R.C.; Gonczy, J.D. (Fermi National Accelerator Lab., Batavia, IL (USA)). pp 227-234 of Advances in cryogenic engineering. Volume 33. Fast, R.W. (ed.). New York, NY; Plenum Press (1988). (CONF-8706125—).

From Cryogenic engineering conference; St. Charles, IL, USA (14 Jun 1987).

The design of the SSC magnet cryostat has been driven by the design of the cold mass suspension and anchor systems. Rigorous structural requirements in combination with low allowable heat loads have resulted in a suspension system that departs from current design practice both in performance concept and materials selection. This paper summarizes suspension and anchor system designs being employed in the SSC and evaluates a post/tie bar system capable of meeting the structural requirements for SSC magnets and exceeding the required thermal performance at 4.5 K.

41024 Improved design for a SSC coil assembly suspension connection. Larson, E.T.; Carson, J.A.; Nicol, T.H.; Niemann, R.C.; Zink, R.A. (Fermi National Accelerator Lab., Batavin, IL (USA)). pp 235-241 of Advances in cryogenic engineering. Volume 33. Fast, R.W. (ed.). New York, NY; Plenum Press (1988). (CONF-8706125—).

From Cryogenic engineering conference; St. Charles, IL, USA (14 Jun 1987).

The connection of the SSC magnet assembly to the cryostat suspension system must withstand shipping and seismic loads, allow axial contraction of the coil assembly, position the coil assembly center within a 0.25 mm radius, provide rotational adjustment of the coil, resist axial quench loads, provide a bearing assembly which is tolerant to high vacuum, high radiation, and cryogenic conditions, and fit within the geometric constraints of the cryostat assembly. A coil assembly suspension connection which meets these criteria is described. Measurements of the effective friction coefficient, static load deflection, and component stresses are compared to the predicted performance. Experience with a full length model of the connection is assessed.

41025 Cryogenic support thermal performance measurements. Gonczy, J.D.; Boroski, W.N.; Nicol, T.H.; Niemann, R.C.; Otavka, J.G.; Ruschman, M.K. (Fermi National Accelerator Lab., Batavia, IL (USA)). pp 243-250 of Advances in cryogenic engineering. Volume 33. Fast, R.W. (ed.). New York, NY; Plenum Press (1988). (CONF-8706125—).

From Cryogenic engineering conference; St. Charles, IL, USA (14 Jun 1987).

The thermal performance of two SSC cryogenic support models is presented. The geometry of each model, its instrumentation, and experimental test arrangement in a heat leak test facility are described. Heat leak and temperature profile measurements made with a primary heat intercept temperature controlled between 10 K and 40 K are presented. Heat leak values to the primary and secondary heat intercepts were derived using the measured temperature profiles and material properties. Measurements of copper cable connections used to heat sink the heat intercepts to their radiation shields are presented. Measurements were also made on identical model supports installed in a full length SSC dipole magnet cryostat thermal model.

41026 SSC dipole magnet cryostat thermal model measurement results. Niemann, R.C.; Boroski, W.N.; Gonczy, J.D.; Nicol, T.H.; Otavka, J.G.; Ruschman, M.K.; Powers, R.J. (Fermi National Accelerator Lab., Batavia, IL (USA)). pp 251-258 of Advances in cryogenic engineering. Volume 33. Fast, R.W. (ed.). New York, NY; Plenum Press (1988). (CONF-8706125—).

From Cryogenic engineering conference; St. Charles, IL, USA (14 Jun 1987).

Thermal performance of the conceptual design SSC dipole magnet cryostat has been experimentally evaluated. A full scale thermal model was built and open cycle thermal performance measurements were made. Objectives of the model program were to utilize and improve the magnet production facility and manufacturing procedures, to evaluate the cryostat design from a production standpoint, to gain experience in magnet handling and transportation, to monitor the transient thermal and structural responses of the cryostat, and to measure the heat leaks to the cold mass and the thermal shields. Details of the measurement program, measurement results, and a comparison of predicted and measured performance are presented.

41027 Thermal performance of candidate SSC magnet thermal insulation systems. Ohmori, T.; Boroski, W.N.; Gonczy, J.D.; Niemann, R.C.; Ruschman, M.K.; Taira, T.; Takahashi, K.; Yamamoto, A.; Hirabayashi, H. (Fermi National Accelerator Lab., Batavia, IL (USA)). pp 323-331 of Advances in cryogenic engineering. Volume 33. Fast, R.W. (ed.). New York, NY; Plenum Press (1988). (CONF-8706125—).

From Cryogenic engineering conference; St. Charles, IL, USA (14 Jun 1987).

Three multilayer insulation blankets, consisting of aluminized polyester film with fiberglass mat spacer, aluminized polyester film with spunbonded nylon spacer, and aluminized dimpled polyester film without spacers, were evaluated in a heat leak test facility. Performance between 300 and 80 K with good and degraded insulating vacuum was studied. The interlayer heat transfer coefficient and the effective thermal conductivity of the blankets were used to compare the different systems and to predict the performance of the SSC magnet insulation.

41028 Cryogenic testing at the SSC string test facility. Theilacker, J.C. (Fermi National Accelerator Lab., Batavia, IL (USA)). pp 577-583 of Advances in cryogenic engineering. Volume 33. Fast, R.W. (ed.). New York, NY; Plenum Press (1988). (CONF-8706125—).

From Cryogenic engineering conference; St. Charles, IL, USA (14 Jun 1987).

A multipurpose cryogenic testing facility was constructed and became operational in 1986 at Fermilab. It consists of a Tevatron satellite refrigerator and a subcooling dewar housed in a building adjacent to a Tevatron refrigerator. A high bay contains power supplies necessary to power SSC magnets, a cryogenic feedcan to interface the refrigerator to the magnet string, and an area for testing Tevatron components. A tunnel has been constructed off the high bay to house a half cell of SSC Design D magnets. The performance of the facility and the schedule for magnet testing are discussed.

41029 Performance of the Los Alamos Proton Storage Ring. Lawrence, G.P. (Los Alamos National Lab., Los Alamos, NM (US)). pp 825-829 of Proceedings of the 1987 IEEE particle accelerator conference: Accelerator engineering and technology. Lindstrom, E.R.; Taylor, L.S. Piscataway, NJ; IEEE Service Center (1987). (CONF-870302—).

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

The Proton Storage Ring (PSR) now in operation at Los Alamos is a high-current accumulator that generates intense 800-MeV proton pulses for driving the Los Alamos Neutron Scattering Center (LANSCE) spallation source. The ring compresses up to 1000-μs -long macropulses from the LAMPF linac into 250-ns bunches and ejects them to a neutron-production target, providing an output optimized for thermal-neutron-scattering research. The design pulser rate and peak pulse intensity of PSR are 12 Hz and 5.2-10^{13} protons per pulse (ppp), yielding 100 μA average current when full performance is reached. This paper summarizes commissioning results and operational experience in the two years since first beam. The PSR has operated in production at average currents up to 30 μA and has reached a peak intensity of 3.4-10^{13} ppp. These achievements represent 30% and 65% of the design objectives. Higher current production has been inhibited by beam losses during accumulation and extraction. Therefore, experiments to understand loss mechanisms have occupied a large fraction of the commissioning effort. Correction of an extraction-channel aperture restriction identified late in 1986 should dramatically reduce extraction losses, which will permit higher current production in 1987. Beam tests in the 10^{13}-ppp range have indicated the presence of a collective instability tentatively identified as transverse. However, by suitable parameter adjustments, the instability threshold can be pushed above the top charge-level attainable with the existing H^- source.

41030 **Thermodynamic mechanism for bunch lengthening.** Meller, R.E. (SSC Central Design Group, Lawrence Berkeley Lab., Berkeley, CA (US)). pp 1155-1157 of Proceedings of the 1987 IEEE particle accelerator conference: Accelerator engineering and technology. Lindstrom, E.R.; Taylor, L.S. Piscataway, NJ; IEEE Service Center (1987). (CONF-870302—).

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

A thermodynamic mechanism for bunch lengthening in electron storage rings is described, where the synchrotron radiation plays the role of a heat bath. The steady state of the bunch is determined by the minimum of free energy, in which the potential energy of bunch displacement is a key part. The result is that bunch oscillation becomes thermodynamically favored when the parasitic losses have displaced the bunch by approximately one rms width from its zero current equilibrium location. This phenomenon is independent of the synchrotron tune shifts, and is unrelated to the mechanical instabilities predicted by the linearized Vlasov equation. This threshold scaling shows that thermodynamic bunch lengthening dominates for short bunches, and a detailed calculation using the power-law impedance shows that this is the probable mechanism for the bunch lengthening in SPEAR II.

41031 **RF impedance studies of a beam chamber and longitudinally slot-coupled vacuum pumping antechamber.** Kustom, R.L.; Nicholls, G.L.; Kramer, S.L.; Khoe, T.K.; Cook, J.M. (Argonne National Lab., 9700 S. Cass Avenue, Argonne, IL (US)). pp 1304-1306 of Proceedings of the 1987 IEEE particle accelerator conference: Accelerator engineering and technology. Lindstrom, E.R.; Taylor, L.S. Piscataway, NJ; IEEE Service Center (1987). (CONF-870302—). Contract W-31-109-ENG-38.

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

The storage ring vacuum chamber of the proposed 7-GeV synchrotron light source at Argonne National Laboratory is planned to have a semi-elliptical beam chamber, with a longitudinal slot coupled to an antechamber containing NEG pumping strips. Concern over the RF impedance of this complex chamber has stimulated the need to understand the limitations it will have on the beam intensity, the RF acceleration system and on the beam lifetime. Calculations using numerical EM field programs have estimated the waveguide modes of this chamber and the impedance and loss parameter for the expected 1-2 cm beam bunch length. The loss parameter is shown to differ little from an elliptical beam chamber without the slot and antechamber. An experimental program has begun to verify the estimates of the impedance for these complex vacuum chamber components using laboratory methods. Preliminary results are presented for the measured loss parameter for a short length of beam vacuum chamber and for other components. These results are compared with their calculated values.

41032 **Betatron phase advance measurement at SPEAR.** Morton, P.L.; Pellegrin, J.L.; Raubenheimer, T.; Ross, M. (Stanford Linear Accelerator Center, Stanford Univ., Stanford, CA (US)). pp 1367-1368 of Proceedings of the 1987 IEEE particle accelerator conference: Accelerator engineering and technology. Lindstrom, E.R.; Taylor, L.S. Piscataway, NJ; IEEE Service Center (1987). (CONF-870302—). Contract AC03-76SF00515.

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

There are many reasons to determine the betatron phase advance between two azimuthal positions in a circular accelerator or storage ring. The authors measured the betatron phase advance between various pairs of azimuthal points in the SPEAR Storage Ring by two different methods. The first method is to excite a steady state coherent betatron oscillation with a network analyzer. The second method is to excite a free coherent betatron oscillation with an impulse kick, and to digitally sample the transverse position of the beam at the pickup stations. The results of these digital samples are Fourier analyzed with a computer to obtain the phase advance. The second method is discussed, and the experimental results compared to theory.

44 INSTRUMENTATION

4401 Radiation Instrumentation

REFER ALSO TO CITATION(S) 39433, 39711, 40423, 40763, 40855, 40856, 40962, 41021, 41099, 41138, 41139, 41791, 41857, 41962, 41990, 42072, 42088, 42089

41033 **(AD-A—190799/7/XAB) Design, fabricate, calibrate, test, and deliver two satellite electron-flux detectors. Final report, 24 September 1979-20 August 1986.** Hunerwadel, J.L.; Sellers, B.; Hanser, F.A. (Panametrics, Inc., Waltham, MA (USA)). Jun 1987. 58p. NTIS, PC A04/MF A01.

A satellite-borne High Energy Electron Analyzer was designed to measure electrons in the range of 1 to 10 MeV. Very low background from omnidirectional charged particles is achieved with two Solid-State Detectors and a BGO scintillator crystal arranged in a telescope unit and with the requirement of a triple coincidence of electrons in the measurement range. Ten energy bins are provided by the BGO over this range. Additionally, electron singles above 10 MeV and proton singles above 15.7 MeV are measured by the BGO crystal. The Solid-State Detectors also provide measurements for proton singles from 4.1 MeV to 269 MeV. The background is further reduced by a plastic scintillator, surrounding the BGO, and placed into anticoincidence with the electron measurement. A complete electron energy spectrum plus singles measurement is generated every .512 seconds. The higher count rates from 3.5 to 1000 kcps are accommodated with compression counters, while the lower count rates are accumulated in straight ripple counters. Three different coincidence requirements (Front SSD coincidence, Back SSD coincidence, Shield anticoincidence) are selectable by ground command. Two instruments were fabricated tested, and calibrated. The first of these has been integrated on the CRRES satellite and is currently undergoing spacecraft testing at BASD.

41034 **(AD-A—192122/0/XAB) Neutron field measurements in phantom with foil-activation methods. Technical report, 29 November 1985-29 November 1986.** Verbinski, V.V.; Cassapakis, C.G. (Science Applications International Corp., San Diego, CA (USA)). 29 Nov 1986. 45p. (SAIC—85-1090-R). NTIS, PC A03/MF A01.

The threshold neutron-foil spectrometry method, utilizing the SAND II spectrum unfolding code, was evaluated by carrying out a measurement in the standard fission-source facility, simultaneous with six (6) in-phantom measurements of neutron spectra. The foil spectrometry was done with the full set of threshold foils, mid-thorax in ER1, where a 2 in. lead wall separated reactor and phantom. A five-foil set was utilized for the phantom mid-head and phantom hip measurements in ER1, as well as for mid-thorax, mid-head and hip in ER2, free field. Calculations of the mid-thorax and mid-head spectra in ER1 and ER2 were carried out, with the source term normalized to nickel foil activations at the reactor entrance window. A simple 5-foil perturbation method for neutron dosimetry, utilizing hand calculations, was developed and evaluated for the ER1 and ER2 spectra. It appears to be the order of 6% accurate versus 3-4% for SAND II, which utilizes the best (calculated) a prior data available for spectral shape information.

41035 (BNL—52114, pp 155-165) **Detector strategies and questions for high luminosities and energies.** Schwitters, R.F. (Harvard Univ., Cambridge, MA (USA)). 1987. NTIS, PC A19/MF A01. Order Number DE88008012/JAW. (CONF-8710107—).

From Future perspectives in high energy physics; Upton, NY, USA (5 Oct 1987).

The central question for experimental particle physics for the remainder of this century is to find what lies beyond the Standard Model. The goal is to find the mass spectrum of new states of matter that are unknown at the present time. These have various names associated with them: Higgs, heavier Z's and W's, supersymmetry, preons, and so on. The general experimental program is much the same as it has been in the recent past: find new mass bumps, or find new event configurations that are clearly distinguishable from the old physics. When such new structures are

found, the next and even more difficult task will be to measure the detailed properties of these particles and the new force laws they imply. The basic strategy for planning a new detector system can be broken down as: (1) decide on the fundamental physics goals, (2) assess available accelerator and detector technology, (3) determine the real-world resources of money and people, and (4) make the necessary choices for the detector design.

41036 **(CEA-CONF—9172) Some new developments in the field of high atomic number semiconductor materials.** Cuzin, M. (CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France). Lab. d'Electronique et de Technologie de l'Informatique). 1986. 41p. (CONF-8603109—). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88753888/JAW.

From 4. European symposium on semiconductor detectors; Munich, F.R. Germany (3 Mar 1986).

A presentation of the main properties of high atomic number materials able to work as room temperature dectectors is made, including present status of synthesis. We summarize some applications in nuclear medical probe, tomography scanners, dosimetry and instrumentation. Mainly focused on CdTe and Hg I/sub 2/ in monocrystal form the presentation will include some industrial applications. Hg I/sub 2/ is also presented as a photodetector associated with scintillators.

41037 **(CERN—88-02) Feasibility of experiments at high luminosity at the large hadron collider. Report of the High-Luminosity Study Group to the CERN Long Range Planning Committee.** Mulvey, J.H. (ed.). (European Organization for Nuclear Research, Geneva (Switzerland)). 22 Apr 1988. 94p. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88703109/JAW.

The studies reported in this volume extend some of those made during Workshop on Physics at Future Accelerators held at La Thuile and CERN in January 1987 (CERN 87-07, Vol. 1 and 2). They consider the feasibility of performing experiments with a 16 TeV proton-proton collider, the Large Hadron Collider (LHC), at luminosities as high as 5.10/sup 34/ cm/sup -2/s/sup -1/. To illustrate the difficulties and the extent to which the potential for discovery at the LHC might be improved by such a step, three specific topics were chosen: searches for a) a massive Higgs boson, b) SUSY gluinos and squarks, and c) a new Z'. Following the Summary Report of the High Luminosity Study Group are papers discussing a possible detector system, radiation levels, and the analyses leading to estimated mass-limits for the searches.

41038 **(CERN-EP—87-169) Introduction to the next generation of linear colliders.** Amaldi, U. (European Organization for Nuclear Research, Geneva (Switzerland)). 19 Sep 1987. 52p. (CONF-8610108—7). NTIS (US Sales Only), PC A04; 1; GPO Dep. Order Number DE88012593/JAW.

From 2. joint US/CERN school on particle accelerators: frontiers of particle beams; South Padre Island, TX, USA (23 Oct 1986).

This paper discusses issues which will influence the choice of future linear acceleraters built. Particular topics discussed are: physics issues and luminosity requirements; scaling laws; beamstrahlung; relations connecting collision parameters; emittance damping; colliders based on copper accelerating structures; and superconducting linear colliders. 57 refs., 11 figs., 11 tabs. (LSP)

41039 **(CERN-EP—87-186) A rich detector with a sodium fluoride radiator: π/K identification up to 3 GeV/c.** Arnold, R.; Guyonnet, J.L.; Giomataris, Y.; Petroff, P.; Seguinot, J.; Tocqueville, J.; Ypsilantis, T. (European Organization for Nuclear Research, Geneva (Switzerland)). 1 Oct 1987. 17p. (CONF-8709153—5). NTIS (US Sales Only), PC A03; 1; GPO Dep. Order Number DE88012600/JAW.

From Conference on position-sensitive detectors; London, UK (7 Sep 1987).

The use of a single crystal of sodium fluoride (NaF) as a Cherenkov radiator has been investigated. Its transparency has been measured and found to be good for photon energies below 9.8 eV. Data on its index of refraction are well fitted to a single-pole Sellmeier resonance formula. These data allow a realistic Monte Carlo simulation of a proximity-focused ring imaging Cherenkov (RICH) system. The photon detector is a multiwire proportional chamber (MWPC) with pad readout. The photosensitive gases considered are tetrakis(dimethylamine)ethylene (TMAE) and triethylamine (TEA). The simulation shows that system having 10 cm radial thickness and 10% of a radiation length of material would identify pions and kaons below 3 GeV/c momentum. The pad dimensions required are about 5 mm {times} 5 mm. 4 refs., 10 figs.

41040 **(CONF-8806102—2) Development of a 10-decade single-mode reactor flux monitoring system.** Valentine, K.H.; Shepard, R.L.; Falter, K.G.; Reese, W.B. (Oak Ridge National Lab., TN (USA)). 31 Mar 1988. Contract AC05-84OR21400. 14p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88008376/JAW.

From Specialists' meeting on instrumentation and reactor core assessment; Cadarache, France (7 Jun 1988).

Conventional wide-range neutron channels employ three optional modes to monitor the required flux range from source levels to full power (typically 10 or more decades). Difficult calibrations are necessary to provide a continuous output signal when such a system switches from counting mode in the source range to mean-square voltage mode in the midrange to dc current mode in the power range. In an ORNL proof-of-principle test, a method of extended range counting was implemented with a fission counter and conventional wide-band pulse processing electronics to provide a single-mode, monotonically increasing signal that spanned {approximately 10} decades of neutron flux. Ongoing work includes design, fabrication, and testing of a comlpete neutron flux monitoring system suitable for advanced liquid metal reactor designs. 6 refs., 4 figs.

41041 **(CRN-HE—87-10) Particle identification in Lep-Delphi experience. Experimental study of photoelectron detection and of Cerenkov angle resolution with the Barrel Rich prototype.** Dracos, M. (Strasbourg-1 Univ., 67 (France). Centre de Recherches Nucleaires). Jun 1987. 200p. (In French). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88753943/JAW.

One of the four LEP experiments, DELPHI, will be equipped with Ring Cherenkov (RICH) detectors for hadrons identification. These detectors will provide pion, kaon, proton identification for momenta from 0.3 to 25 GeV/c over nearly all the solid angle. The technique of the long drift is used which combines liquid and gas radiators on opposite sides of a simple photosensitive drift volume. A full-scale prototype of the DELPHI Barrel RICH was built to study the feasibility and the performances of a big RICH system. We have obtained: - an absorption length of photoelectrons in the drift gas more than 10 m; - a merit factor of 53 cm/sup -1/ for the liquid radiator (perfluoro-hexane C/sub 6/F/sub 14/) and 77 cm/sup -1/ for the gas radiator (isobutance iC/sub 4/H/sub 10/) - a resolution of the single photon Cerenkov angle of 11.5 mrad for the liquid radiator and 4.5 mrad for the gas radiator.

41042 **(DOE/ER/40039—23) A study of the response of a gas ionization chamber to different sources of ionizing radiation.** Zamble-Dieguez, F.E. (Texas A and M Univ., College Station (USA). Dept. of Physics). May 1988. Contract AS05-81ER40039. 52p. NTIS, PC A04/MF A01;1; GPO Dep. Order Number DE88011182/JAW.

The response of the TAMU Forward Hadron Calorimeter Chambers to neutrons from a ^{239}Pu-Be source was investigated in hope of developing a strategy to reduce the effects of the background events called {open-quotes}Texas towers{close-quotes} in the CDF trigger for the next run. The response to a standard (^{55}Fe γ-ray) energy source was also studied and found to be similar to that of the chambers installed at CDF. In addition, the effects of different sampling gases and intermediate absorbers on the rate of large energy pulses were investigated. The neutron data were compared with the energy spectrum measured in CDF and that simulated using Monte Carlo techniques. It was found that the large energy pulse frequency can be reduced by as much as 50% if a non-hydrogenous sampling gas is used in conjunction with a neutron moderator.

41043 **(FEI—1730) Methods of spectrometer calibration by means of isotopic neutron sources.** Trykov, L.A.; Kolevatov, Yu.I.; Volkov, V.S. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk. Fiziko-Ehnergeticheskij Inst.). 1985. 76p. (In Russian). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88703121/JAW.

Methods and experimental data concerning calibration of neutron and gamma spectrometers by means of radionuclide sources are systematized. Problems of acquisition of reliable data on energy distribution of neutrons and gamma-radiation using a complex of spectrometers (scintillation, multisphere and the one on the basis of a hydrogen proportional counter) are discussed. Data on amplitude and energy distribution of neutrons and gamma-radiation of different radionuclide sources as well as neutrons and gamma-radiation leaking from spherical mock-ups with radionuclide source placed in their counters are presented. Data on characteristics of the spectrometers necessary for transformation of apparatus data to neutron energy spectra are given. It is concluded that homogeneous (Pu-Be, Pu-B, Cf) neutron sources may be used for current check, maintenance and calibration of an operating neutron and gamma scintillation spectrometer as well as a multisphere neutron spectrometer. For most thorough test and calibration of a scintillation neutron spectrometer it is advisable to use mock-ups in which conditions of narrow geometry are realized and to use heterogeneous (Pu-Be, Pu-/sup 10/B) neutron sources. 6 refs.; 2 figs.; 7 tabs.

41044 **(FEI—1846) Calculating the resolution function of double time-of-flight spectrometer for slow neutrons.** Alenicheva, T.V.; Lisichkin, Yu.V.; Novikov, A.G.; Semenov, V.A.; Yadrovskij, E.L. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk. Fiziko-Ehnergeticheskij Inst.). 1987. 10p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88703124/JAW.

Calculations of resolution function of double time-of-flight spectrometers - DIN-1M and DIN-2PI - for slow neutrons were conducted using the developed PEZIN program for BESM computer by the Monte Carlo method. The effect of the following factors on resolution function was considered: final dimensions of the sample and detector, geometrical configuration of the sample, semiwidth of energy distribution of monochromatic neutrons after the rotor, neutron scattering angle. It is shown that the shape of resolution function under certain conditions can be non-Gauss one. Therefore it is necessary to carry out preliminary calculation investigation of spectrometer resolution function when planning the measurements and choosing the experiment parametersw. 10 refs.; 5 figs.; 1 tab.

41045 **(FRCEA-TH—68) Study of a neutron spectrometer using a Helium-3 proportional counter.** Duffar, M. (Conservatoire National des Arts et Metiers (CNAM), 75 - Paris (France); CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Service de Protection contre les Rayonnements). Jun 1978. 64p. (In French). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88754206/JAW.

Theory on helium 3 proportional counters is recalled. Pulse rise time discrimination imply irradiation at the end of the detector. Neutron energy range is from 50 keV to 8 MeV. The realization of the spectrometry assembly is described together with the transfer matrix calculation. Differential spectra of neutron emitted by the source Am-B, Am-F, and Am-Li were experimentally found to verify the process method which is proposed.

41046 **(IEN-DIQUI—4/85) 'GAMAL' program to multiplets analysis in α, γ and x spectrometry.** Bernedo, L.F.B. (Instituto de Engenharia Nuclear, Rio de Janeiro (Brazil)). Jul 1985. 14p. (In Portuguese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88701578/JAW.

To analyse multiplets and complet all the resources of spectral analysis, the 'GAMAL' program was written in ORACL to be used in ORTEC 6240-42 system. Using both units of 'floppy disk', many spectros of program can automaticaly be analysed. (M.L.J.).

41047 **(IFVE-OEA—87-73) Unified interface modules of the Elektronika-60 microcomputer for automatization of control of instrument precision unit motion.** Aliev, F.M.; Goncharov, V.A.; Kurkin, Yu.L.; Longinov, V.D.; Popov, A.V. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1987. 18p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703178/JAW.

Unified interface modules of the "Elektronika-60" microcomputer intended for the control system of scanning-measuring device replacement for signal processing from bubble chambers are described. The control equipment contains the following modules: synchronous highway for transmission of data and control signals, the highway controller, the modulus of controller interface with microcomputer highway and a unified control modulus. The block-diagrams of the mentioned modules are given; their operation is considered. Utilization of the developed modules permits to increase reliability of the motion control system, to simplify its electronics as well as to expand functional opportunities of the control system. 6 refs.; 7 figs.

41048 **(IFVE-OEF—87-1) Pulsed high-voltage supply as a way to improving proportional chamber performances when working with intensive particle beams.** Lavrent'ev, V.I.; Morozov, A.A.; Myalitsyn, V.K.; Chujko, B.V. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1987. 4p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88703181/JAW.

Characteristics of proportional chambers operating with "magic" gas mixture after long-term operation in the intense beams are investigated. Long-term operation of proportional chambers is stated to result in increase of dark current and drop of detection efficiency. It is caused by appearance of a spatial charge in the interelectrode gap of proportional chambers or near anode wire. An effective method is suggested for restoration of proportional chamber efficiency; the method presupposed pulsed supply of proportional chambers. In this case the range og operating voltages increases by 250 V, that ensures reliable operation of proportional chambers at beam intensity up to 3.7x10/sup 6/ s/sup -1/. 6 refs.; 5 figs.

41049 **(IFVE-OEF—87-99) Study of mesons with gluon component including glueballs and mesons with high spins with the help of multiphoton 4π-spectrometer.** Prokhoshkin, Yu.D. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1987. 32p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703183/JAW.

The results of the sixth joint experiment IHEP-CERN are discussed. The purpose of the experiment was to study meson spectroscopy and to search for new particles. In beam data collection on light meson rare decays, dynamics of charge-exchange processes and on meson pair production is finished. Studies of meson production with a reinforced gluon component and glueballs at the GAMS-200 facility in IHEP and at the 450 VeV accelerator CERN are started. The design of the GAMS-4P modernized facility permitting to register central interactions and inclusive production of charmed particles is considered. The modernized spectrometer has a solid angle of $\sim 4\pi$ and the dynamic range of (0.2-40) GeV. A wide-aperture hodoscopic gamma-quantum detector, a protection system, the GAMS-200 hodoscopic cellular gamma-quantum detector, a modular hadron calorimeter and a system of wire chambers are the main elements of the spectrometer. The data collection system permits to record on magnetic tape up to 200 events/s. Ways of further modernization of the GAMS-4P facility for studies on a 3 TeV beam for investigation of gluon interactions are considered. 40 refs.; 21 figs.

41050 **(INFN/TC—86-15) Holographic method for the measurement of the sagitta of a thin electrode of a parallel plate counter.** Guidi, C.; Bellazzini, R.; Brez, A.; Massai, M.M.; Torquati, M.R. (Istituto Nazionale di Fisica Nucleare, Rome (Italy)). 1986. 6p. (In Italian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88701594/JAW.

An holographic method for the measurement of the sagitta of the thin electrode of a position sensitive parallel plate counter is presented. The method is simple but very sensitive (about 1μm).

41051 (INIS-mf—11232, pp 221-228) **Airborne gamma spectrometry in Western Bohemia and Sumava Mountains area.** Dedacek, K.; Vesely, V. (Geofyzika, n.p., Brno (Czechoslovakia); Uranovy Pruzkum, Liberec (Czechoslovakia)). 1987. (In Czech). NTIS (US Sales Only), PC A11/MF A01. Order Number DE88703055/JAW. (CONF-8710342—).

From Mining Pribram in science and technology; Pribram, Czechoslovakia (12 Oct 1987).

A four-channel differential gamma spectrometer by Geometrics with NaI(Tl) scintillation crystals as detectors was used for measurements. The survey was performed in a scale of 1:25,000, the flight level was 60 to 100 m, the profile point density was 30 to 40. The Sumava Mountains and Western Bohemia areas were measured in the years 1983 to 84 and the results are presented in form of maps of total gamma activity isolines and K, U and Th concentration isolines. The computer-processed results are assessed from the geological point of view. The new method of data processing allows using statistical characteristics of concentration fields and radioactive element ratios and their planar representation. (M.D.). 6 refs,. 1 fig.

41052 **(INS—670) Guide note for spectral analysis in the S-3500 system.** Yasue, M.; Wada, T. (Tokyo Univ., Tanashi (Japan). Inst. for Nuclear Study). Feb 1988. 29p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88754102/JAW.

Instructions how to use a program for spectral analysis are briefly described. The program which was originally coded by T. Wada was modified so that one can handle spectral data displayed on a graphic terminal by conversing with the super-mini computer S-3500 through a keyboard or a touch-pen. It was also improved in several points such as 1) easy to handle, 2) speedy in analyses 3) versatile curves for continuum background in spectra 4) available for spectral data with several types of 8, 16, 20, 24 or 32 bits/channel.

41053 **(IPEN-Pub—118) Proposal of a dosemeter for skin beta radiation dose assessment.** Rosa, L.A.R. da; Caldas, L.V.E. (Instituto de Pesquisas Energeticas e Nucleares, Sao Paulo (Brazil)). Aug 1987. 15p. (In Portuguese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88701634/JAW.

Beta radiation is, undoubtedly, less penetrating than X or gamma radiation. Thus, beta radiation sources external to the human body do not cause a significant irradiation of its deeper tissues. However, in some cases, they may contribute in a very important way to the irradiation of the lens of the eyes and, mainly, of the skin. Specially, the hands and finger tips may receive a high dose. In this work some relevant aspects of the individual monitoring in beta radiation fields are discussed and the importance of monitoring this kind of radiation in some activities where the skin absorbed dose may be a limiting factor is evidenced. The main characteristics of the thermoluminescent (TL) response of ultra-thin CaSO/sub 4/ : Dy detectors (UT-CaSO/sub 4/ : Dy) in the detection of this kind of radiation are also studied. The irradiation are performed with /sup 90/Sr /sup 90/Y, /sup 204/Tl and /sup 147/Pm sources. The reproducibility, linearity, dependence on the absorbed dose rate, optical fading, energy and angular dependences of the detector TL responce are investigated. Transmission factors for different thicknesses of tissue equivalent material are obtained for the TL detectors using the three available beta sources. Based on the results obtained, a dosemeter for skin beta radiation absorbed dose assessment with an energy dependence better than 12% is proposed.

41054 **(IPNO-DRE—87-27) Mass identification in heavy ion collection with the spectrometer Soleno.** Hourani, E.; Fortier, S.; Gales, S. (Paris-11 Univ., 91 - Orsay (France). Inst. de Physique Nucleaire). 1987. 41p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88752435/JAW.

A detection system consisting of a thin film scintillator detector and a solid state detector has been set up and used to measure the time of flight and energy of the fusion evaporation residues collected with the magnetic spectrometer SOLENO at the Orsay Tandem. The linear responses and the timing properties of the system were tested using a /sup 252/Cf source and beams of /sup 16/O, /sup 32/S and /sup 58/Ni. The system was used to study the mass identification and the collection yield obtained with SOLENO.

41055 **(IPNO-DRE—87-28) High resolution β-detector.** Charon, Y.; Cuzon, J.C.; Tricoire, H.; Valentin, L. (Paris-11 Univ., 91 - Orsay (France). Inst. de Physique Nucleaire). 1987. 13p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88752447/JAW.

We present a detector which associates a charge coupled device to a light amplifier. This image sensor must detect weak β-activity, with a 10 μm resolution and should replace the autoradiographic films used for molecular hybridization. The best results are obtained with the /sup 35/S emittor, for which the resolution and the efficiency are respectively 20 μm and 100% (relative to the measured standard source).

41056 **(ITEF—96(1987)) Positron tomographs. Status and prospects of development.** Sidorin, I.V.; Mukhin, V.I. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1987. 20p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703299/JAW.

Specifications of position emission tomographs used for examination of brain and internal organs of human beings are presented. The tomograph comprises a detecting system, devices for detector displacement, sighting, calibration, electronics units (discriminators-formers, coincidence circuits, coders, buffer memory), detectors for detecting system position, bed for patient. Spatial resolution of the tomograph is determined by sizes of the detectors and their dispositin relatively to the object of examination. Besides, it depends on positron path in the investigated medium, deflections of the angle of scatter of annihilation quanta from 180 deg, distribution of points of gamma-quantum interaction by depth of the detector, filter and algorithm of image reconstruction, motion of organs of a patient, motion of labelled pharm-preparation in the organism. Such factors as absorption of annihilation radiation by substance of an object, radiation scattering and registration of random coincidences essentially affect the quality of tomographic image. It is shown that use of asseblies of microchannel plates and a scintillator on the base of barium fluoride permits to produce a coordinate-sensitive detector for a tomograph complying with highest requirements. 46 refs.; 5 figs.

41057 **(ITEF—187(1986)) Calculation of average energy and diffusion coefficients of excess electrons in condensed krypton.** Bolozdynya, A.I.; Safronov, G.A. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1986. 17p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703313/JAW.

The behaviour of excess electrons in condensed noble gases used as working media of ionizing detectors is considered. Dependences of average energy and excess energy diffusion coefficients on electric field intensity in liquid and solid crypton have been calculated within the framework of the Lekner-Cohen model. The above technique for calculating diffusion coefficients and average electron energy coefficients was used for argon as well. The results obtained in condensed argon reveal a satisfactory agreement with a large group of calculation and experimental data of different authors which proves the authenticity of the calculation technique chosen. 14 refs.; 6 figs.; 1 tab.

41058 **(ITEF—193(1986)) Multiwire proportional chambers for wide-aperture magnetic spectrometer.** Alekseev, A.N.; Bogdanov, E.T.; Vishnevskij, M.E. and others. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1986. 25p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703314/JAW.

Design of large multiwire proportional chambers 0.48x1.28 m/sup 2/ and 0.88x1.84 m/sup 2/ in size, their production process and readout systems are described. The results of parameter control and the chamber characteristics are presented. 5 refs.; 9 figs.

41059 **(JINR—13-87-305) Data acquisition and processing system for the 8004-01 type stationary dosimetric control device.** Arkhipov, V.A.; Elizarov, O.I.; Ishmukhametov, M.Z.; Solodilov, A.V.; Shevechka, Sh. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics). 1987. 4p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88701654/JAW.

Data acquisition and processing system for the 8004-01 type stationary dosimetric control device has been developed and introduced of the IBR-2 reactor. Information from 120 channels of four signal sections of the device goes to the microprocessor for processing. 4 refs.; 3 figs.

41060 **(JINR—13-87-476) Total absorption scintillation spectrometer for neutrons.** Dzhelepov, V.P.; Zinov, V.G.; Konin, A.D.; Rudenko, A.I.; Solov'eva, G.M.; Fil'chenkov, V.V. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1987. 10p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88703332/JAW.

Submitted to the journal MIM.

Total absorption neutron spectrometer, designed for investigating the muon catalysis process, is described. A liquid scintillator, its volume being 24 l , is used as a neutron detetor. This allows one to sufficiently increase the rate of event collecting and to effectively use the muon catalysis multiplicity phenomenon for a more reliable determination of its parameters. The investigation into the detector characteristics has shown, that its detection efficiency is close to 100% within (2-6)MeV neutron energy range, and its time resolution makes up 5 ns. The spectrometer also performs a reliable n-γ separation, beginning with 50 KeV threshold energy. 14 refs.; 6 figs.

41061 **(JINR—18-87-289) Automatic radiochromatographs for the analysis of labelled compounds of flat samples.** Anisimov, Yu.S.; Zanevskij, Yu.V.; Ivanov, A.B.; Movchan, S.A.; Peshekhonov, V.D.; Cheremukhina, G.A.; Chernenko, S.P.; Abdushukurov, D.A. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy; AN Tadzhikskoj SSR, Dushanbe. Fiziko-Tekhnicheskij Inst.). (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1987. 8p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88703336/JAW.

A small series of two-dimensional radiochromatographs of the RD-01 type has been developed and constructed. The radiochromatographs are used for the analysis of compounds labelled by radionuclides on flat samples operating on-line with a DVK-1 microcomputer. A radiochromatograph intended to detect the tritium radiation has a minimum sensitivity of 270 pCi/cm/sup 2/ at a spatial resolution of 0.7 mm. The radiochromatographs based on multistep avalanche chambers are used to operate with /sup 14/C, /sup 32/P, /sup 33/P, /sup 35/S and /sup 125/I isotopes. The spatial resolution of the radiochromatographs in 1-2 mm at a minimum sensitivity of 16.7 and 90 pCi/cm/sup 2/ for /sup 14/C, /sup 32/P and /sup 125/I, respectively. 11 refs.; 6 figs.; 2 tabs.

41062 (JINR—R-7-86-322, pp 58) **Electrostatic separators of complete fusion reaction products in heavy ion beam of the Vasilisa installation.** Eremin, A.V.; Tarabrin, V.A.; Stepantsov, S.V.; Obukhov, Yu.L.; Ter-Akop'yan, G.M. 1986. (In Russian). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88780065/JAW.

In Heavy ion physics - 1985. Collection of annotations of the Nuclear Reaction Laboratory of the Joint Nuclear Research Institute works, 1985.

41063 (JINR—R-7-86-322, pp 70) **4π-spectrometer for products of nuclear reactions with heavy ions. FOBOS project.** Vill, Eh.; Zodan, Kh.; Kupchak, R. 1986. (In Russian). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88780065/JAW.

In Heavy ion physics - 1985. Collection of annotations of the Nuclear Reaction Laboratory of the Joint Nuclear Research Institute works, 1985.

41064 **(JINR—R-10-87-241) Computerized keeping of the history logbook of an event processing for chamber experiment.** Balgansurehn, Ya. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Computing Techniques and Automation). 1987. 10p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88701671/JAW.

A method for computerized logbook keeping of measurement results processing for chamber films as well as the corresponding software are described. The logbook created by this method is one of the elements of the automated systems for film data mathematical processing. It allows to form automatically data summary tapes and summ up the processing by program. A method and the software were tested for two experiments about 70 thousand events have been processed with their help. 10 refs.; 3 figs.

41065 **(JINR-R—6-87-518) Protective coatings for high purity germanium detectors.** Bel'tsazh, E.; Kotlyarski, A.; Slapa, M.; Brylovska, I.; Kalinina, N.N.; Osipenko, B.P.; Revenko, A.V.; Yurkovski, Ya.; Srnka, D. (Institute for Nuclear Studies, Otwock-Swierk (Poland); Uniwersytet Marii Curie-Sklodowskiej, Lublin (Poland); Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems; Ceskoslovenska Akademie Ved, Rez. Ustav Jaderne Fyziky). (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1987. 4p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88703410/JAW.

The possibility of applying the protective coating on pn-junctions of HPGe-detectors is shown. The glassy SiO/sub 2/ coating was applied in vacuum unit equipped with electron gun. The coating markedly increases the number of detector thermocycles and makes possible the periodic cleaning of the detectors. 1 ref.; 3 figs.

41066 **(JINR-R—10-87-639) PAIS semiautomated measuring system. General description.** Belyaev, A.V.; Krasnoslobodtsev, V.I.; Moroz, V.I. and others. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Computing Techniques and Automation). 1987. 22p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703416/JAW.

PAIS semiautomated measuring system has been worked out and elaborated in 1981-1986. PUOS, SAMET devices and operating personnel are connected with the ES-1033 computer by means of the local terminal systems ES-7920 (ROBOTRON) and ES-7912 - ES-7917 (MERA-ELZAB). Special processors of the channels, ES-7922.01M, ES-7912 made it possible to combine the received information with the data analysis. Software is written in PASCAL and is based on the OS ES, RTS operating systems and their sevice means. 23 refs.; 5 figs.; 3 tabs.

41067 **(KFK—4303) Test of an albedo neutron dosimetry system: TLD calibration and readout procedure, neutron calibration, dosimetry properties, routine application.** Piesch, E.; Burgkhardt, B. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Hauptabteilung Sicherheit). Mar 1988. 118p. (In German). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88753829/JAW.

The two-component albedo dosemeter in use consists of an universal boron-loaded plastic encapsulation, the beta and albedo neutron windows of which are adopted to the corresponding TLD system of the manufacturers Alnor, Harshaw, Panasonic and

Vinten. Beside the TLD detectors the capsule may contain also track etch detectors. Within a BMU project the system was investigated by four governmental measurement services in the FRG with respect to its qualification for personnel monitoring with emphasis in the readout and calibration procedures for the TLD system, the evaluation technique for the estimation of the photon and neutron dose equivalent in routine monitoring and the calibration of the personnel dosemeter in stray neutron fields. The test has shown the readiness of the system to act in the application areas of nuclear power reactors and linacs behind heavy shieldings, in the fuel element cycle, use of fissile materials, criticality, use of radionuclide sources, high energy particle accelerators. The uncertainty due to energy dependence was found to be within a factor of 2 for a single application area. In the case of irradiations from the front half space the dose equivalent H'(10) is indicated sufficiently independent of the direction of the radiation incidence. After completion of the test the albedo dosemeter became the official neutron personnel dosemeter in the FRG. It allows the separate estimation of the dose equivalent of hard beta radiation, photon radiation and neutrons. (orig./HP)

41068 **(KFK—4348) Characterization of CR 39 nuclear track detector for use as a radon/thoron dosemeter.** Kandaiya, S. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Hauptabteilung Sicherheit). Feb 1988. 45p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88753831/JAW.

For the estimation of radon, thoron and their short-lived daughter products in air radon diffusion chambers with passive α-track etch detectors have been used. The report describes the properties of CR 39 track etch detectors in particular with respect to the spectrometric detection of α-particles in the energy range up to 8.77 MeV using chemical and a combination of chemical-electrochemical etching technique. In order to optimize the etching conditions for an α-energy discrimination in the energy range up to 8.77 MeV, the ECE track size diameter and the track density have been investigated as a function of the chemical pre-etching time using three electrical field strengths. In a mixed α-spectrum the contributions of various α-particles with energies between 4.6 to 8.77 MeV have been determined experimentally in CR 39 and compared with the spectral measurement using a surface barrier detector and the same irradiation geometry. Beside CR 39 detectors etched chemically and electrochemically, in addition surface barrier detectors and a Monte Carlo calculation have been used to evaluate the α-energy spectrum for thoron and its daughter products emitted by α-decays in the air volume and the plate-out of daughters at the inner surface on the diffusion chamber. (orig./HP)

41069 **(KIYI—87-2) TV raster display for the representation and analysis of data files.** Ofengenden, R.G.; Svetlichnyj, P.N.; Golik, V.V.; Doronin, M.I. (AN Ukrainskoj SSR, Kiev. Inst. Yadernykh Issledovanij). 1987. 19p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703448/JAW.

A raster-code display is described, used for the representation of graphic and symbol information at screen of TV-type monitor in automatization systems of nuclear-physics experiments and also in other systems where CAMAC interface is used. In comparison with the other displays a described one has enlarged possibilities on addressing, representation of data files. 7 refs.; 6 figs.

41070 **(PB—88-211826/XAB) NBS (National Bureau of Standards) measurement services: calibration of x-ray and gamma-ray measuring instruments. Final report.** Lamperti, P.J.; Loftus, T.P.; Loevinger, R. (National Bureau of Standards, Washington, DC (USA). Center for Radiation Research). Mar 1988. 140p. (NBS/SP—250/16). NTIS, PC A07/MF A01.

Also available from Supt. of Docs. See also PB—87-174041; Library of Congress catalog card No. 88-600515.

The calibration and irradiation of x-ray and gamma-ray instruments are performed in terms of the physical quantity exposure. The calibrations are listed in NBS Special Publication 250 as calibrations 46010C through 46050S (formerly 8.3A through 8.3M). A calibration or correction factor is provided for radiation detectors, charge sensitivity of a high-gain electrometer is tested, and passive dosimeters are given known exposures. Calibration is performed by comparing the instrument against an NBS primary standard of exposure, which is a free-air chamber for x-rays and a cavity ionization chamber for cesium-137 and cobalt-60 gamma rays. A variety of quality-assurance checks are performed to assure the constancy of the standards and the accuracy of the calibrations and irradiations. The overall uncertainty is given as 0.7% for exposure rate in the NBS beams, 1% for calibration of a cable-connected chamber and irradiation of passive dosimeters, and 1.5% for calibration of a condenser chamber.

41071 **(PNL—6452) Performance criteria for dosimeter angular response.** Roberson, P.L.; Fox, R. A.; Cummings, F. M.; McDonald, J. C.; Jones, K.L. (USDOE Assistant Secretary for Environment, Safety, and Health, Washington, DC; Pacific Northwest Lab., Richland, WA (USA)). Jun 1988. Contract AC06-76RL01830. 44p. NTIS, PC A04/MF A01;1; GPO Dep. Order Number DE88012753/JAW.

This report provides criteria for evaluating the response of personnel dosimeters to radiation at nonperpendicular incidence. The US Department of Energy Laboratory Accreditation Program (DOELAP) ensures that dosimetry systems at DOE facilities meet acceptable standards for precision and accuracy. In the past, these standards were limited to tests for system variability, energy dependence, and level of detection. The proposed criteria will broaden the scope of DOELAP to include the angular response of personnel dosimeters. Because occupational exposures in the workplace are rarely due to radiation from only one direction, dosimeters must accurately assign individual dose equivalent from irradiation at any forward angle of incidence. Including an angular response criterion in DOELAP would improve the quality of personnel monitoring provided that the criterion is developed from appropriate dose quantities. This report provides guidance for assigning individual dose equivalents for radiation fields at nonperpendicular incidence to the dosimeter. 21 refs., 10 figs., 10 tabs.

41072 **(SLAC-PUB—4611) Triggering, front-end electronics, and data acquisition for high-rate beauty experiments.** Johnson, M.; Lankford, A.J. (Fermi National Accelerator Lab., Batavia, IL (USA); Stanford Linear Accelerator Center, Menlo Park, CA (USA)). Apr 1988. Contract AC03-76SF00515;AC02-76CH03000. 17p. (CONF-8711128—13). NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88012730/JAW.

From Workshop on high sensitivity beauty physics at Fermilab; Batavia, IL, USA (11 Nov 1987).

The working group explored the feasibility of building a trigger and an electronics data acquisition system for both collider and fixed target experiments. There appears to be no fundamental technical limitation arising from either the rate or the amount of data for a collider experiment. The fixed target experiments will likely require a much higher rate because of the smaller cross section. Rates up to one event per RF bucket (50 MHz) appear to be feasible. Higher rates depend on the details of the particular experiment and trigger. Several ideas were presented on multiplicity jump and impact parameter triggers for fixed target experiments. 14 refs., 3 figs.

41073 **(SLAC-PUB—4636) A FASTBUS-based software trigger for the Mark II detector at the SLC.** Aleksan, R.; Briggs, D.; Glanzman, T.; Grosse-Wiesmann, P.; Holmgren, S.; Komamiya, S.; Schaad, M.; Tinsman, J. (Stanford Linear Accelerator Center, Menlo Park, CA (USA); Lawrence Berkeley Lab., CA (USA)). May 1988. Contract AC03-76SF00515. 3p. (LBL—25299; CONF-8803123—1). NTIS, PC A02. Order Number DE88012738/JAW.

From International conference on the impact of digital microelectronics and microprocessors on particle physics; Trieste, Italy (28 Mar 1988).

A new software trigger scheme has been developed to augment and enhance the existing charged and neutral triggers by providing sensitivity to new event topologies and some level of control over accelerator-induced backgrounds. Historically, the Mark II existed with two primary trigger components: a charged track finder based upon the central and vertex drift chambers and the time-of-flight counters; and an electromagnetic trigger based upon the total

energy deposited in each of ten calorimeter modules. The trigger component of the new system is based upon the Mark II electromagnetic calorimetry but with significantly increased granularity and the inherent flexibility of software. Trigger processing also benefits from the relatively long period of time (up to 8.3 ms) between SLC beam crossings. The production of long-lived neutral particles provides an example of an event topology which would not have triggered in the old system. By decaying beyond the first few drift chamber layers, such particles avoid the charged particle trigger, yet could produce clear signals in the calorimeters. Another example is the class of events containing a single photon as the visible particle such as occur in the reaction $e^+e^- \rightarrow Z^0\gamma \rightarrow \nu\nu\gamma$. Sensitivity to this reaction is necessary to measure the number of neutrino generations. One goal of the new trigger is to achieve nearly 100% efficiency for single photons of energy above 750 MeV. Such a trigger necessarily depends upon a very low and well understood accelerator background for success. A minimum ionizing particle trigger will provide good efficiency for $Z^0 \rightarrow \mu\mu$ or {tau}{tau} at the angles covered by the end cap calorimeters which increases the capabilities for measuring the forward-backward asymmetries. And finally, an improved trigger is more sensitive to complete surprises. 7 refs., 4 figs.

41074 (ZfK—592, pp 164-167) **/sup 6/Li glass spectrometer for low energy fission neutrons.** Lajtai, A.; Kecskemeti, J.; Dyachenko, P.P.; Kutsaeva, L.S.; Seregina, E.A. (Hungarian Academy of Sciences, Budapest. Central Research Inst. for Physics; Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk. Fiziko-Ehnergeticheskij Inst.). Apr 1986. NTIS (US Sales Only), PC A09/MF A01. Order Number DE88780092/JAW. (CONF-8511312—).

From 15. international symposium on nuclear physics - nuclear fission; Gaussig, German D.R. (11 Nov 1985).

Application of a 9.55 mm thick NE912 glass detector in a time of flight spectrometer is described for energy spectrum measurement of fission neutrons with energy of 20 keV - 1.2 MeV.

41075 (ZfK—592, pp 188-194) **Low background telescopic system for study of (n,α) reactions on light nuclei.** Trzcinski, A.; Burzynski, S.; Rusek, K.M.; Turkiewicz, I.M. (Institute for Nuclear Studies, Otwock-Swierk (Poland)). Apr 1986. NTIS (US Sales Only), PC A09/MF A01. Order Number DE88780092/JAW. (CONF-8511312—).

From 15. international symposium on nuclear physics - nuclear fission; Gaussig, German D.R. (11 Nov 1985).

A complex telescopic system is developed in order to measure differential cross sections of /sup 12/C(n,α)/sup 9/Be reaction with high accuracy in a full angular range. The measuring method allows to obtain backgroundless data for large part of angular distribution. The experimental set up with the target-detector assembly is described and the results are analyzed. The distribution of the directions and energies of the /sup 9/Be nuclei associated with the alpha particles emitted at a given laboratory angle are calculated by means of a Monte Carlo code.

41076 (ZfK—592, pp 146-151) **Application of magnetic analysis in the time correlation associated particle method.** Kalinin, V.A.; Kovalenko, S.S.; Kuzmin, V.N.; Nemilov, Yu.A.; Solin, L.M.; Shpakov, V.I.; Fomichev, A.V. (Radievyj Inst., Leningrad (USSR)). Apr 1986. NTIS (US Sales Only), PC A09/MF A01. Order Number DE88780092/JAW. (CONF-8511312—).

From 15. international symposium on nuclear physics - nuclear fission; Gaussig, German D.R. (11 Nov 1985).

An application of the time-correlated associated particle method (TCAPM) for absolute measurements of neutron induced fission cross sections in the neutron energy region from 1.7 to 2.5 MeV is presented. The experimental set up with the magnetic analysis in the associated particle channel as well as the characteristics of the associated particle channel.

41077 (ZfK—592, pp 160-163) **CAMAC data acquisition system and data analysis in Time-Correlated Associated Particle Method (TCAPM) fission cross-section measurements at the tandem accelerator of the Central Institute for Nuclear Research Rossendorf.** Pausch, G.; Herbach, C.M.; Merla, K.; Musiol, G.; Fromm, W.D.; Ortlepp, H.G. (Technische Univ., Dresden (German Democratic Republic); Zentralinstitut fuer Kernforschung, Rossendorf bei Dresden (German Democratic Republic)). Apr 1986. NTIS (US Sales Only), PC A09/MF A01. Order Number DE88780092/JAW. (CONF-8511312—).

From 15. international symposium on nuclear physics - nuclear fission; Gaussig, German D.R. (11 Nov 1985).

A CAMAC data acquisition system, based on a ROBOTRON KRS 4201 minicomputer, was developed to record simultaneously all experimental data which are needed to determine precise fission cross-section values by means of the TCAP method. Hardware configuration and basic software components are described.

41078 (ZfK—592, pp 168-172) **Employing of gadolinium loaded large liquid scintillation counters of research of neutron multiplicity distribution in separate channels of reactions.** Alkhazov, I.D.; Daniel, A.V.; Dmitriev, V.D.; Dushin, V.N.; Kovalenko, S.S.; Petrzhak, K.A.; Kuznetsov, A.V.; Malkin, L.Z.; Petrov, B.F.; Shpakov, V.I. (Radievyj Inst., Leningrad (USSR)). Apr 1986. NTIS (US Sales Only), PC A09/MF A01. Order Number DE88780092/JAW. (CONF-8511312—).

From 15. international symposium on nuclear physics - nuclear fission; Gaussig, German D.R. (11 Nov 1985).

A gadolinium loaded large liquid scintillation counter used for prompt neutron multiplicity distribution measurements are presented. Experimental set up as well as characteristics for 2π- or 4π-geometry measurements are reported. Specially the determination of the counting efficiency in the 2π-geometry and unfolding of initial multiplicity distributions proceedings from the experimentally measured ones are discussed. The employed method of unfolding was based on an approximation of the multiplicity distributions by convolutions of model probability distributions, whose parameters were selected from the conditions of the experimental momenta descriptions. The Poya generalized distribution was found to be the most advantageous and producing the best description of the experimental data.

41079 (ZfK—592, pp 156-159) **Identification of associated particles in the Time-Correlated Associated Particle Method (TCAPM) fission cross section measurements at the tandem accelerator of the CINR Rossendorf.** Ortlepp, H.G.; Herbach, C.M.; Merla, K.; Musiol, G.; Pausch, G. (Zentralinstitut fuer Kernforschung, Rossendorf bei Dresden (German Democratic Republic); Technische Univ., Dresden (German Democratic Republic)). Apr 1986. NTIS (US Sales Only), PC A09/MF A01. Order Number DE88780092/JAW. (CONF-8511312—).

From 15. international symposium on nuclear physics - nuclear fission; Gaussig, German D.R. (11 Nov 1985).

The Time-Correlated Associated Particle Method was applicated to fission cross-section measurements in the neutron energy regions near 8.5, 4.5, and 19 MeV. The DD- and DT-reactions were used at a 5 - 10 MeV deuteron beam of the CINR tandem-van-de-Graaff-accelerator. To reach sufficient AP counting rates, neutron production targets of up to 3 mgcenter dotcm/sup -2/ were used. Several problems connected with the high rate of scattered deuterons and with charged particles from other reactions could be solved with an especially developed equipment. A telescope of two Si-SB-detectors in connection with a fast timing, a high rate pulse height spectroscopy system and a specialized fast particle identification circuit was utilized. AP counting rates up to 5000 s/sup -1/ were obtained. Rates of scattered deuterons of 10/sup 5/ s/sup -1/ could be tolerated. The portion of not separated background events amounted to 2 - 6%.

41080 **Miniature radiation dosimeter for in vivo radiation measurements.** Hughes, R.C.; Huffman, D.; Snelling, J.V.; Zipperian, T.E.; Ricco, A.J.; Kelsey, C.A. (Sandia National Labs., Albuquerque, NM (USA)). *International Journal of Radiation Oncology, Biology and Physics;* **14**: No. 5, 963-967(May 1988).

We have made initial characterization measurements on a miniature radiation dosimeter which can be used for in vivo radiation measurements. It consists of a radiation sensing field effect transistor (RADFET) mounted in a 0.8 mm OD plastic catheter. The RADFET acts as a dosimeter by storing trapped charge proportional to absorbed dose. The stored charge signal can be differentiated to give dose rate. We report on the techniques for mounting, a circuit for dose readout, drift of the readings, linearity of response, temperature and angular dependence, and unpowered operation of the device.

41081 **Construction and initial operation of a proportional wire detector for use in a Cerenkov ring imaging system.** Vavra, J.; Bienz, T.; Bird, F.; Gaillard, M.; Halkwell, G.; Kwon, Y.J.; Leith, D.; Ratcliff, B.; Rensing, P.; Schultz, D. (Stanford Linear Accelerator Center, P.O. Box 4349, Stanford, CA (US)). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* **35**: No. 1, 487-492(Feb 1988). (CONF-871006—).

From 34. nuclear science symposium and 19. nuclear power systems symposium; San Francisco, CA, USA (21 Oct 1987).

The authors report on the final version of the multiwire single electron detector for the Cherenkov ring imaging device at SLD. They describe recent RandD effort to define the design parameters; they describe the details of the geometry of the detector, and experimental tests with the detector itself.

41082 **A low jitter, low cost, time-of-flight circuit.** Cable, M.D.; Derzon, M.S.; Vieira, R.G.; Spracklen, H.P. (Univ. of California, Lawrence Livermore National Lab., P.O. Box 5508, Livermore, CA (US)). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* **35**: No. 1, 133-134(Feb 1988). (CONF-871006—).

From 34. nuclear science symposium and 19. nuclear power systems symposium; San Francisco, CA, USA (21 Oct 1987).

A low cost circuit has been developed for use in a neutron time-of-flight spectrometer at the Nova Laser Facility. Using a silicon charged-particle detector, amplifier and constant-fraction discriminator, timing resolution of better than 50 ps FWHM has been achieved. Using an array of many such detectors, very high data rates and precise spectra can be obtained.

41083 **Ballistic deficit correction in semiconductor detector spectrometers.** Goulding, F.S.; Landis, D.A. (Lawrence Berkeley Lab., Univ. of California, Berkeley, CA (US)). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* **35**: No. 1, 119-124(Feb 1988). (CONF-871006—).

From 34. nuclear science symposium and 19. nuclear power systems symposium; San Francisco, CA, USA (21 Oct 1987).

At high energies, the energy resolution of γ-ray spectrometers using large-diameter coaxial germanium detectors can be dominated by "ballistic deficit" effects, particularly when short processing times are used to permit high rate operation. This results from the fact that rise-time variations in the detector signal are reflected in amplitude fluctuations after the signals pass through pulse shapers. The paper describes a method of compensating for these effects on a pulse by pulse basis using the fact that the loss of amplitude for slowly-rising signals is accompanied by a delay in the peak time of the shaped output signal. The simple analog corrector circuit uses a relationship whereby the amplitude deficit is roughly proportional to the square of the time delay in the peak. Results show considerable improvements in the energy resolution of germanium γ-ray spectrometers at high energies.

41084 **The hybridized front end electronics of the central drift chamber in the Stanford Linear Collider Detector.** Lo, C.C.; Kirsten, F.A.; Nakamura, M.; Jared, R.C.; Goulding, F.S.; Yim, A.; Moss, J.; Freytag, D.; Haller, G.; Larson, R. (Lawrence Berkeley Lab., Univ. of California, Berkeley, CA (US)). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* **35**: No. 1, 142-145(Feb 1988). (CONF-871006—).

From 34. nuclear science symposium and 19. nuclear power systems symposium; San Francisco, CA, USA (21 Oct 1987).

In order to accommodate the high packaging density requirements for the front end electronics of the Central Drift Chamber (CDC) in the SLAC Linear Collider Detector (SLD), the CDC front end electronics has been hybridized. The hybrid package contains eight channels of amplifiers together with all the associated circuits for calibration, event recognition and power economy switching functions. A total of 1280 such hybrids are used in the CDC.

41085 **Engineering tradeoffs in miniaturization of electronics for very large detectors.** Larsen, R.S. (Stanford Linear Accelerator Center, Stanford Univ., Stanford, CA (US)). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* **35**: No. 1, 138-141(Feb 1988). (CONF-871006—).

From 34. nuclear science symposium and 19. nuclear power systems symposium; San Francisco, CA, USA (21 Oct 1987).

The advent of the ASIC together with several related developments is being felt in the field of very large scale detectors in a unique way. Indeed, these developments are coming at a time when yet another increase in the magnitude of detectors for the Superconducting Super Collider (SSC) is being considered. Undoubtedly the timely advent of ASIC's is doing its share in fueling development of systems considered impractical a few short years ago. Research, by it nature, demands innovation. However, very large scale detectors require a level of highly disciplined engineering if they are to be built within time and budgetary constraints, and an excessive level of innovation in the design can be a hindrance rather than an advantage toward the chief end. How do the authors judge the level to which new electronics technology should be introduced into a new detector design? Drawing from experience associated with the on-going design of the large SLAC detector known as SLD, slated for completion by 1989, this paper will explore these questions.

41086 **Status of the silicon strip vertex detector for the Mark II experiment at the SLC.** Adolphsen, C.; Gratta, G.; Litke, A.; Schwarz, A.; Turala, M.; Breakstone, A.; Parker, S.; Barnett, B.; Dauncey, P.; Drewer, D. (Santa Cruz Institute for Particle Physics, Univ. of California, Santa Cruz, CA (US)). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* **35**: No. 1, 424-427(Feb 1988). (CONF-871006—).

From 34. nuclear science symposium and 19. nuclear power systems symposium; San Francisco, CA, USA (21 Oct 1987).

The authors are constructing a silicon strip vertex detector to be used in the Mark II detector in the study of Z^0 decays at the SLAC Linear Collider. The status of the project, including the performance of the individual silicon detector modules, is presented.

41087 **Capacitive charge division in centroid finding cathode readouts in MWPCs.** Smith, G.C.; Fischer, J.; Radeka, V. (Brookhaven National Lab., Upton, NY (US)). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* **35**: No. 1, 409-413(Feb 1988). (CONF-871006—).

From 34. nuclear science symposium and 19. nuclear power systems symposium; San Francisco, CA, USA (21 Oct 1987).

A technique is described in which the centroid of induced charge on cathode strips in a proportional chamber can be determined with reduced differential and integral nonlinearity, without increasing the number of readout channels. It is based on capacitive charge division from intermediate cathode strips to adjacent readout strips, and may be applied to a variety of position readout principles.

41088 **A scintillating fiber-optic active target (SFT) for studies of high energy photoproduction.** Ruchti, R.; Baumbaugh, B.; Bishop, J.; Busenitz, J.; Cason, N.; Cunningham, J.; Gardner, R.; Kennedy, C.; Mannel, E.; Mountain, R.J. (Dept. of Physics, Univ. of Notre Dame, Notre Dame, IN (US)). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* **35**: No. 1, 441-445(Feb 1988). (CONF-871006—).

From 34. nuclear science symposium and 19. nuclear power systems symposium; San Francisco, CA, USA (21 Oct 1987).

A high resolution, gateable, Scintillating Fiber Target (SFT) has been developed for Fermilab Experiment E687 to study charm and beauty particle production and decay in high energy photon interactions. The detector consists of a scintillating target of either GS1 Cerium glass fibers or polystyrene fibers of 29μm cross section, a multi-stage image intensifier and an intensified CCD or SIT/VIDICON camera system used in conjunction with a custom-built video data acquisition system.

41089 **Test stands for the central drift chamber front end hybrid in the Stanford Linear Collider Detector.** Lo, C.C.; Yim, A.K. (Lawrence Berkeley Lab., Univ. of California, Berkeley, CA (US)). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* **35**: No. 1, 456-459(Feb 1988). (CONF-871006—).

From 34. nuclear science symposium and 19. nuclear power systems symposium; San Francisco, CA, USA (21 Oct 1987).

The Central Drift Chamber (CDC) of the SLCA Linear Collider Detector (SLD) uses 1280 front end electronic hybrid modules. Each of these modules contains over 450 components and performs numerous functions. This paper describes the four test stands for production and detailed circuit characterizations of these hybrids. Descriptions and performance of some of the important functions of the test systems are presented here.

41090 **A new scintillating glass for high energy physics applications.** Puseljic, D.; Baumbaugh, B.; Bishop, J.; Busenitz, J.; Cason, N.; Cunningham, J.; Gardner, R.; Kennedy, C.; Mannel, E.; Mountain, R.J. (Dept. of Physics, Univ. of Notre Dame, Notre Dame, IN (US)). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* **35**: No. 1, 475-476(Feb 1988). (CONF-871006—).

From 34. nuclear science symposium and 19. nuclear power systems symposium; San Francisco, CA, USA (21 Oct 1987).

A new scintillating glass has been developed containing Cerium (3+) oxide in an aluminate host-glass. In this material the scintillation emission spectrum is red-shifted relative to that observed for Ce/sup 3+/ in silicate glasses. Additionally, emission and absorption spectra are more widely separated in the aluminate composition, suggesting that such glasses might have improved light transmission properties. The refractive index is high, making it a potentially interesting material for use in fiber-optic tracking detectors.

41091 **Cryogenic detectors of particles: Hopes and challenges.** Sadoulet, B. (Dept. of Physics, Univ. of California, Berkeley, CA (US)). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* **35**: No. 1, 47-54(Feb 1988). (CONF-871006—).

From 34. nuclear science symposium and 19. nuclear power systems symposium; San Francisco, CA, USA (21 Oct 1987).

The authors review the various methods proposed for cryogenic detection of particles, the current status of their development and their potential applications.

41092 **The response of scintillators to heavy ions - I. Plastics.** McMahan, M.A. (Accelerator and Fusion Research Div., Lawrence Berkeley Lab., Berkeley, CA (US)). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* **35**: No. 1, 42-46(Feb 1988). (CONF-871006—).

From 34. nuclear science symposium and 19. nuclear power systems symposium; San Francisco, CA, USA (21 Oct 1987).

The response of various scintillator detectors to ions of A = 1 - 84 and energies E/A = 5 - 30 MeV have been measured, and are found to be linear above and energy of 100 MeV. Results are presented for a typical organic plastic scintillator including parameterizations of the data as a function of Z, A, and energy. These results can be used by anyone using scintillators as heavy ion detectors, with one calibration point giving a normalization that allows use of the whole set of curves. The response functions are compared to previous parameterizations at lower energies and discussed in terms of the theory of δ-ray formation in the scintillator.

41093 **Phonon - mediated particle detection.** Neuhauser, B.; Cabrera, B.; Martoff, C.J.; Young, B.A.; Lee, A.T. (Dept. of Physics and Astronomy, San Francisco State Univ., San Francisco, CA (US)). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* **35**: No. 1, 65-69(Feb 1988). (CONF-871006—).

From 34. nuclear science symposium and 19. nuclear power systems symposium; San Francisco, CA, USA (21 Oct 1987).

When an incident particle collides with an electron or nucleus in an insulating crystal, the recoil kinetic energy is converted rapidly into a burst of low-energy phonons. If the crystal is very pure and free of defects, and if it is very cold, (T—0.1K), the phonons will propagate ballistically for distances of several centimeters. The authors report on experiments with two types of superconducting phonon sensors being considered for use on a new kind of particle detector, called a Silicon Crystal Acoustic Detector (SiCAD), which reads out phonons generated by particle scattering events.

41094 **Orbiting transmission source for positron tomography.** Huesman, R.H.; Derenzo, S.E.; Cahoon, J.L.; Geyer, A.B.; Moses, W.W.; Uber, D.C.; Vuletich, T.; Budinger, T.F. (Donner Lab. and Lawrence Berkeley Lab., Univ. of California, Berkeley, CA (US)). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* **35**: No. 1, 735-739(Feb 1988). (CONF-871006—).

From 34. nuclear science symposium and 19. nuclear power systems symposium; San Francisco, CA, USA (21 Oct 1987).

Accidental suppression and effective data rates have been measured for the orbiting transmission source as implemented in the Donner 600-Crystal Positron Tomograph. A mechanical description of the orbiting source and a description of the electronics used to discard scattered and accidental events is included. Since accidental coincidences were the rate-limiting factor in transmission data acquisition, the new method allows us to acquire sufficient transmission data in a shorter time with a more active transmission source.

41095 **Cylindrical pet detector design.** Burham, C.A.; Kaufman, D.E.; Chesler, D.A.; Stearns, C.W.; Wolfson, D.R.; Brownell, G.L. (Physics Research Lab., Massachusetts General Hospital Boston, MA (US)). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* **35**: No. 1, 675-679(Feb 1988). (CONF-871006—).

From 34. nuclear science symposium and 19. nuclear power systems symposium; San Francisco, CA, USA (21 Oct 1987).

A cylindrically shaped high resolution PET detector that uses cross-plane coincidence events is being developed. A 2-D analog coded position sensitive detector is employed. It consists of a hexagonal array of PM Tubes and a rectangular array of crystals, 8 elements per PM Tube. The optics has been designed to maximize the light collection and to provide uniform spatial resolution. The detector will be 60 cm D X 11.5 cm W, the crystals are 3 X 5.7 X 30 mm. The design, associated electronics and results of measurements on a sector of the detector are presented.

41096 **Design concepts for the ASTROMAG cryogenic system.** Green, M.A. Castles, S. (Lawrence Berkeley Lab., CA (USA)). pp 631-637 of Advances in cryogenic engineering. Volume 33. Fast, R.W. (ed.). New York, NY; Plenum Press (1988). (CONF-8706125—). Contract AC03-76SF00098.

From Cryogenic engineering conference; St. Charles, IL, USA (14 Jun 1987).

The cryogenic system used to cool the superconducting magnet for the ASTROMAG Particle Astrophysics Facility is described. A liquid He II storage concept is proposed which would permit cryogenic lifetimes of up to three years between refills. The concept uses superfluid helium pumped by the thermomechanical effect. In-orbit resupply of the storage tank is also proposed. A

method for charging and discharging the magnet with minimum helium loss using split gas-cooled leads is discussed. The use of a stirling cycle cryocooler to extend cryostat storage life is also evaluated.

41097 **Open questions in closed-loop photodetection.** Shapiro, J.H. Cambridge, MA; Massachusetts Institute of Technology (1987). vp.

The usual open-loop quantum and semiclassical theories of light detection apply to configurations in which there is no feedback from the photodetector to the light bean impinging on that detector. In these circumstances there are unmistakable signatures of nonclassical light, such as sub-shot-noise spectra and sub-Poisson photocounts. No such unmistakable signatures exist for the case of closed-loop photodetection, i.e., for configurations in which there is a feedback path from the detector to the light source. Recent progress in the theory of closed-loop photodetection is reviwed, and possible future schemes for quantum-state synthesis and quantum-measurement synthesis are extrapolated. This presentation is represented by viewgraphs.

41098 **The Soudan 2 nucleon decay experiment.** Thron, J.L. (Argonne National Lab., Argonne, IL (US)). pp 106-117 of Proceedings of the seventh workshop on grand unification/ICOBAN '86. Arafune, J. Teaneck, NJ; World Scientific Pub. Co. (1987). (CONF-8604202—).

From 7. workshop on grand unification; Toyama City, Japan (16 Apr 1986).

The Soudan 2 nucleon decay experiment consists of 1.1 Kton fine grained iron tracking calorimeter. It has a very isotropic detection structure which along with its flexible trigger will allow detection of multiparticle and neutrino proton decay modes. The detector has now entered its construction stage.

4402 Radiation Effects On Instrument Components, Instruments, Or Electronic Systems

REFER ALSO TO CITATION(S) 40458

41099 **(AD-A—192121/2/XAB) Radiation-hard sensors for surveillance. Final report, 15 September 1987-14 March 1988.** Endal, A.S.; Drukier, A.K. (Applied Research Corp., Landover, MD (USA)). 11 Mar 1988. 107p. (ARC-R—88-162). NTIS, PC A06/MF A01.

The authors report development of a Radiation Hard Sensor for Surveillance. The sensor is being developed by Applied Research Corporation, under an SBIR program. The sensor is based on a Superheated Superconducting Colloid Detector (SSCD). Detection of x rays, gamma rays, and neutrons is monitored by superconducting quantum interference devices (SQUID). Considerable progress has been made in demonstrating that high spatial resolution is possible, and especially that these superconducting detectors are not sensitive to radiation damage up to 35 MRads. High-quality, low noise amplifiers were constructed in order to take advantage of the SQUID sensitivity. Multichannel readout capability is presently being built.

41100 **Hard error generation by neutron-induced fission fragments.** Browning, J.S.; Gover, J.E.; Wrobel, T.F.; Hass, K.J.; Nasby, R.D.; Simpson, R.L.; Posey, L.D.; Boos, R.E.; Block, R.C. (Sandia National Labs., P.O. Box 5800, Albuquerque, NM (US)). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* **NS-34**: No. 6, 1269-1274(Dec 1987). (CONF-8707112—). Contract AC04-76DP00789.

From Annual conference on nuclear and space radiation effects; Snowmass Village, CO, USA (28 Jul 1987).

The authors observed that neutron-induced fission of uranium contaminants present in alumina ceramic package lids results in the release of fission fragments that can cause hard errors in metal-nitride-oxide nonvolatile RAMs (MNOS NVRAMs). Hard error generation requires the simultaneous presence of (1) a fission fragment with a linear energy transfer (LET) greater than 20 MeV/mg/cm/sup **2/ moving at an angle of 30 degrees or less from the electric field in the high-field, gate region of the memory transistor, and (2) a WRITE or ERASE voltage on the oxide-nitride transistor gate. In reactor experiments, they observe these hard errors when a ceramic lid is used on both MNOS NVRAMs and polysilicon-nitride-oxide (SNOS) capacitors, but hard errors are not observed when a gold-plated kovar lid is used on the package containing these die. They mapped the tracks of the fission fragments released from the ceramic lids with a mica track detector and used a Monte Carlo model of fission fragment transport through the ceramic lid to measure the concentration of uranium present in the lids. The authors' concentration measurements are in excellent agreement with other's measurement of uranium concentration in ceramic lids. The authors' Monte Carlo analyses also agree closely with their measurements of hard error probability in MNOS NVRAMs.

41101 **Variations in semiconductor device response in a medium-energy x-ray dose-enhancing environment.** Beutler, D.E.; Fleetwood, D.M.; Beezhold, W.; Knott, D.; Lorence, L.J. Jr.; Draper, B.L. (Sandia National Labs., Albuquerque, NM (US)). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* **NS-34**: No. 6, 1544-1550(Dec 1987). (CONF-8707112—).

From Annual conference on nuclear and space radiation effects; Snowmass Village, CO, USA (28 Jul 1987).

The authors performed a series of experiments to investigate the response of semiconductor devices to medium-energy x-ray irradiation under conditions in which dose-enhancement effects are very important. They find that the response of MOS capacitors to the same "dose-enhanced" radiation depends not only on the increased dose, but also on the incident radiation spectra, device temperature and processing, and/or oxide thickness and electric field. In many cases, these dependencies cannot be explained simply in terms of existing knowledge of basic mechanisms of radiation effects on MOS devices (for example, electron-hole recombination and hole transport and trapping), or by present Monte Carlo electron/photon transport codes such as the Integrated Tiger Series (ITS). In addition, the response of semiconductor diodes to the "dose-enhanced" radiation appears to be qualitatively different from that of MOS capacitors, and differs markedly in value from the ITS code predictions. These results demonstrate that an improved understanding of semiconductor device response to "enhanced" radiation is needed to assure simulation fidelity of tests of devices to be used in dose-enhancing environments.

4403 Miscellaneous Instruments

REFER ALSO TO CITATION(S) 39088, 39666, 40122, 40600, 40617, 40735, 41150, 41622, 42306, 42324, 42346, 42445

41102 **(DP—1747) Ultra-clean underground counting facility for low-level environmental samples.** Winn, W.G.; Bowman, W.W.; Boni, A.L. (Savannah River Lab., Aiken, SC (USA)). Sep 1987. Contract AC09-76SR00001. 57p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88009235/JAW.

An underground counting facility has been designed and constructed to improve detection of low-level radionuclides. The 3.0 x 4.3 x 2.4 m counting chamber is placed 14.3 m below ground, has 10.2-cm thick walls of pre-WWII naval armor plate, and is further shielded by a minimum of 1.2 m of specular hematite. The total overburden of shielding is equivalent to 31.7 m of water. Careful selection of building materials and a special air filtering system maintain a cleanroom environment with minimum contamination potential. Background improvements are noted relative to an earlier ground-level counting chamber with 30.5-cm-thick walls of pre-WWII naval armor plate. Performance appraisals of facility detectors include a large dual NaI(Tl) coincidence system, three smaller NaI(Tl) detectors, and HPGe well detecotr, and gas proportional and Geiger counters. Major electronics for the detectors are located at a ground level control center to eliminate any associated backgrounds. Because an individual sample may be counted several days, uninterruptable power is used. An IBM PC/XT computer processes spectra from multi-channel analyzers using custom-developed software. 25 refs., 15 figs., 7 tabs.

41103 **(EUR—10964) Development and exploitation of the slit method for the characterization of x-ray screen-film combinations.** Hoeschen, D. (Commission of the European Communities, Luxembourg). 1987. 50p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88752399/JAW.

For the determination of the modulation transfer function (MTF) of screen-film combinations which are used in medical x-ray diagnostics a measuring method has been developed: the screen-film combination is exposed to x-rays behind a thin slit and the modulation transfer function is calculated from the resulting rather broad slit images on the film. After solving many technical and photographic problems, the slit method provides high precision in the MTF determination. The only objection against this method is the necessary high dose variation which has to be provided by the x-ray machine.

41104 **(EUR—10965) Determination of the Modulation Transfer Function of Screen-Film Combinations in X-ray photography by the grating method.** Hoeschen, D. (Commission of the European Communities, Luxembourg). 1987. 25p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88752397/JAW.

An intercomparison experiment concerning the determination of the Modulation Transfer Function (MTF) of Screen-Film Combinations in x-ray photography by the grating method was made. Six laboratories located in four countries participated. Each laboratory has used its own, individually developed measurement procedure. The results have shown a surprisingly good agreement, the standard deviation (1 σ value) of MTF values reported by the different laboratories was about +- 0.02.

41105 **(FEI—1867) Independent working place on the base of the DVK-2M computer and UNO-4096 analyzer.** Zajtsev, M.Yu.; Balandin, A.F. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk. Fiziko-Ehnergeticheskij Inst.). 1987. 5p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88703128/JAW.

Independent working place on the base of the DVK-2M microcomputer and UNO-4096-90 analyzer, designated for investigations of the field of reactor and protection physics is described. Two ways of the analyzer connection with the DVK-2M microcomputer are suggested : by means of CAMAC system or direct connection of UNO-analyzer with the DVK-2M processor. 3 figs.

41106 **(GKSS—86/E/65) Foil-strain-gauge-based displacement transducers and calibration device for displacement transducers.** Balzereit, K.H.; Rohwerder, G.; Dietzel, W. (GKSS-Forschungszentrum Geesthacht G.m.b.H., Geesthacht-Tesperhude (Germany, F.R.)). 1986. 12p. (In German). (CONF-8611229—). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88753790/JAW.

From Lecture and discussion meeting on materials testing, with posters; Bad Hauheim, F.R. Germany (27 Nov 1986).

Materials testing performed on various specimen materials with different techniques often reveal measuring method problems which cannot be solved by using commercial devices which are either too expensive or else are non-existent altogether. The institute remedied this situation by developing a number of laboratory devices of their own make two of which, i.e. a special displacement transducer and a device for the calibration and characteristics determination of transducers, are demonstrated in this report. (orig./HP)

41107 **(IPNO-T—87-03) Radio-imaging devices with scintillating plastic optical fibers.** Raymond, C. (Paris-11 Univ., 91 - Orsay (France)). Jun 1987. 109p. (In French). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88752429/JAW.

Different solutions envisaged before this study are quickly reviewed. The systematic study of the different steps are described: from the detector to the image processing. The development of the first mockups and the technologic problems encountered are presented. The first results are given, together with the comparisons with current techniques. Numerical simulations are presented.

41108 **(ITEF—82(1987)) Diagnostics and tuning stand on the microcomputer base.** Leonov, I.A.; Skachkov, Yu.V. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1987. 8p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88703294/JAW.

The operation of a diagnostics and tuning stand for the electronic equipment involved in 'Elektronika-60' computer or performed in the 'camac-vector' standard is described. The stand is made on the base of 'Elektronika-60' and connected with the central computer compatible with the stand computer in command system, software and interface through an asynchronous interface of succesive exchange with the central computer. This connection provides serial stands with a broad variety of peripheral devices of central computer. 2 refs.; 3 figs.

41109 **(ITEF—118(1987)) Reconstruction the KROKUS scanning measuring projector.** Neustroev, V.D. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1987. 15p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703303/JAW.

Modernized scanning measuring projector, designated for primary scanning of films from bubble chambers is described. Detailed consideration is given to electronic circuit for controlling film-pulling mechanism in three modes: slow pulling, fast pulling and start-stop conditions. Controle unit for scanning device contains the following basic elements: the circuit of controlling by operating elements, photorelay circuit, phase shifting unit and supply unit of projector lamps and electric drive. The maximal image dimension on the screen - 400X600 mm. Film-pulling mechanism enables to load both 35 and 50 mm films. 2 refs.; 4 figs.

41110 **(JINR-R—10-87-562) Interface of a micro-computer with a multichannel analyzer.** Le Dinh Lam; Nguen Ngok Khoan. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics; Inst. Fiziki NTsNI, Khanoj (SRV)). (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics). 1987. 4p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88703414/JAW.

A block of interface of the M6800 micro-computer with a multichannel analyzer is described. By this inteface an information from the analyzer is transferred to micro-computer, processed in it by the given program, recorded on flexible magnetic disc and could be transferred back to the analyzer. The use of developed programs permits to improve the spatial resolution of spectra and diminish the background of cosmic rays registered in proportional counter. The rate of data transfer between micro-computer and analyzer is 1200 baud. 3 refs.; 3 figs.

41111 **(JINR-R—13-87-527) Mesooptical fourier-transformation microscope: the structure of signals in the sagittal section.** Soroko, L.M. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1987. 10p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88703420/JAW.

The structure of the signals at the output of the Mesooptical Fourier-Transform Microscope (MFTM) for nuclear research emulsion in the sagittal section is analyzed. It is shown that the MFTM in the sagittal section can be considered as one-dimensional pin-hole chamber. The relations between the resolution of the MFTM in the sagittal section and the diameter of the field of view for the whole system are presented. There are described the experiments which illustrate the essence of the processes in the MFTM, support the ability of the MFTM to localize spatially the end of the straight line particle track in the field of view of the system, and also make more clearly the relations obtained in the paper. The extreme angular and spatial resolution of the MFTM which can be attained in the really working system are deduced finally. 7 refs.; 14 figs.

41112 (KEK—87-13, pp 25-34) **High-sensitivity detector for radio astronomy.** Inetani, Junji. (Tokyo Univ., Nagano (Japan). Nobeyama Radio Obsevatory). Sep 1987. (In Japanese). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88780097/JAW. (CONF-8706325—).

From Meeting on high-power, high-frequency power sources; Oho, Japan (4 Jun 1987).

This report deals with techniques currently used in radio astronomy for the purpose of 'detection of super-high frequency waves of very small power'. In general, the T/sub A/ (antenna temperature) of intersteller molecules is in the range of 0.1 - 10 K and the width of the line spectra is in the range of 100 KHz-1 MHz. Thus, the received power is as small as 10/sup -19/ - 10/sup -16/W. On the other hand, the noise inherent in the receiving system, or the system noise temperature, is as high as 500 - 1000 K. A decrease in system noise temperature is indispensable for high-sensitivity detection of astronomical signals. Four types of amplifiers for centimeter waves are currently available: FET type, parametric type, HEMT type and maser type. Millimeter waves are also amplified by these amplifiers after being converted into centimeter waves by a low-noise mixer. Therefore, the performance of a millimeter wave receiver depends greatly on that of the mixer used. It was revealed in 1978 that a super-low noise millimeter wave can be constructed using the tunnel-type Josephson device (or SIS device). Here, a 40 GHz-band SIS receiver is developed and compared with a conventional semiconductor-type receiver. (Nogami, K.).

41113 (KFKI—1987-79/E) **Multidisc neutron velocity selector.** Rosta, L.; Zsigmond, Gy.; Farago, B.; Mezei, F.; Ban, K.; Perendi, J. (Hungarian Academy of Sciences, Budapest. Central Research Inst. for Physics). Dec 1987. 23p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703433/JAW.

The prototype of a velocity selector for neutron monochromatization in the 4-20 A wavelength range is presented. The theoretical background of the multidisc rotor system is given together with a description of the mechanical construction and electronic driving system. The first tests and neutron measurements prove easy handling and excellent parameters. (author) 6 refs.; 7 figs.; 2 tabs.

41114 (MLM-MU—88-66-0005) **Troubleshooting guide for Mound calorimeter systems.** Breakall, K.L.; Duff, M.F.; Rodenburg, W.W. (Monsanto Research Corp., Miamisburg, OH (USA). Mound). 29 Jun 1988. Contract AC04-76DP00053. 26p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88012409/JAW.

This report is to be used as a tool for troubleshooting Mound calorimeter systems. It describes in simple language the equilibration, prediction, and servo-control modes of operation. A problem-cause-action table provides suggestions and, in some cases, directs personnel to one of six troubleshooting flow charts included in the report. Using the flow charts, laboratory personnel should be able to recognize and troubleshoot most problems that occur. 4 figs., 1 tab.

41115 (N—88-19760) **DIRBE External Calibrator (DEC). Final report.** Wyatt, C.L.; Thurgood, V.A.; Allred, G.D. (Utah State Univ., Logan (USA)). Aug 1987. 558p. (NASA-CR—180761; NAS—1.26:180761; CSE—87-056). NTIS, PC A24/MF A01.

Under NASA Contract No. NAS5-28185, the Center for Space Engineering at Utah State University has produced a calibration instrument for the Diffuse Infrared Background Experiment (DIRBE). DIRBE is one of the instruments aboard the Cosmic Background Experiment Observatory (COBE). The calibration instrument is referred to as the DEC (Dirbe External Calibrator). DEC produces a steerable, infrared beam of controlled spectral content and intensity and with selectable point source or diffuse source characteristics, that can be directed into the DIRBE to map fields and determine response characteristics. This report discusses the design of the DEC instrument, its operation and characteristics, and provides an analysis of the systems capabilities and performance.

41116 (OH/RD—87/250/K) **Towards field holography.** Mader, D.L. (Ontario Hydro Research Div., Toronto (Canada)). 24 Nov 1987. 15p. (MICROLOG—88-01791). Ontario Hydro Research Division, Editorial Section, 800 Kipling Ave., Toronto, Ont., Canada M8Z 5S4; $10.00 CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

The structural integrity of pressure vessels and pipes could now be assessed by holography in the field environment with further development of the prototype equipment described in this report. Previously, holographic interferograms of pressurized components were made on a vibration isloation table with a continous wave (cw) laser. Now, interferograms have been obtained without use of vibration isolation using pulsed ruby and yttrium-aluminum-garnet lasers to freeze motion. Instead of hologram viewing with a separate cw laser, the pulsed laser itself was used with a video camera and frame grabber to capture the image and hold it between viewing pulses. Techniques to overcome unwanted motion of the test piece are described, so that fringes due to deformation alone can be seen. 24 refs., 9 figs.

41117 (PNL-SA—14743) **The US Department of Energy Personnel Dosimetry Evaluation and Upgrade Program.** Faust, L.G.; Stroud, C.M.; Swinth, K.L.; Vallario, E.J. (Pacific Northwest Lab., Richland, WA (USA); USDOE, Washington, DC). Nov 1987. Contract AC06-76RL01830. 5p. (CONF-880404—14). NTIS, PC A02/MF A01. Order Number DE88008198/JAW.

From 7. international congress of the International Radiation Protection Association; Sydney, Australia (10 Apr 1988).

The US Department of Energy (DOE) Personnel Dosimetry Evaluation and Upgrade Program is designed to identify and evaluate dosimetry deficiencies and to conduct innovative research and development programs that will improve overall capabilities, thus ensuring that DOE can comply with applicable standards and regulations for dose measurement. To achieve these goals, two programs were initiated to evaluate and upgrade beta measurement and neutron dosimetry. 3 refs.

41118 (PPPL—2524) **Development of data acquisition and analysis software for multichannel detectors.** Chung, Y. (Princeton Univ., NJ (USA). Plasma Physics Lab.). Jun 1988. Contract AC02-76CH03073. 26p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88011876/JAW.

This report describes the development of data acquisition and analysis software for Apple Macintosh computers, capable of controlling two multichannel detectors. With the help of outstanding graphics capabilities, easy-to-use user interface, and several other built-in convenience features, this application has enhanced the productivity and the efficiency of data analysis. 2 refs., 6 figs.

41119 (RPT/CRY—62463/BOP) **Development of a multiplexer module for use in a spaceborne cryogenic environment based on GaAs MESFET technology. Final report.** Fitzgerald, A. (Radiotechnique-Combelec, Paris (France)). 1987. 77p. (ESA-CR(P)—2450; ETN—88-91414). NTIS, PC A05/MF A01.

A transistor for use in a cryogenic multiplexer was chosen, and cryogenic multiplexing devices were manufactured and tested. An N-ON transistor with 1.5 micron gate length was chosen as the best compromise between performance and reliability. With a width of 150 microns the transistor has a low enough ON resistance (channel resistance). The manufactured multiplexing devices have two 10:1 multiplexers on board, with 5 common control lines, packaged in a 28 pin DIL ceramic package. Tests show that the multiplexers are suitable for use in the proposed applications. For voltage at the channel under 0.3 V channel resistance is less than 300 ohms. Leakage currents are less than 5 nA in all cases.

41120 **(UCRL—98601) The use of multilayer diffraction gratings in the determination of x-ray, soft x-ray, and VUV elemental scattering cross-sections.** Barbee, T.W. Jr. (Lawrence Livermore National Lab., CA (USA)). Apr 1988. Contract W-7405-ENG-48. 10p. (CONF-880110—32). NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88009049/JAW.

From SPIE O-E Lase '88: optoelectronics and laser applications in science and engineering; Los Angeles, CA, USA (10 Jan 1988).

The dispersion of light by multilayer combined microstructure diffraction gratings is affected by the scattering cross-sections of the elements used to synthesize the multilayer. This effect will be analytically evaluated, and the results of model calculations for spectral regions of interest presented. Experimental results for these domains will also be presented and compared with data from the literature and with the results of modelling calculations. 12 refs., 7 figs., 1 tab.

41121 **Development of mercuric iodide energy dispersive x-ray array detectors.** Iwanczyk, J.S.; Warburton, W.K.; Dabrowski, A.J.; Hedman, B.; Hodgson, K.O.; Patt, B.E. (Univ. of Southern California, Institute of Physics, 4676 Admiralty Way, Suite #932, Marina del Rey, CA (US)). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* **35**: No. 1, 93-97(Feb 1988). (CONF-871006—).

From 34. nuclear science symposium and 19. nuclear power systems symposium; San Francisco, CA, USA (21 Oct 1987).

There are various areas of synchrotron radiation research particularly Extended X-Ray Absorption Fine Structure (EXAFS) on dilute solutions and anomalous scattering, which would strongly benefit from the availability of energy dispersive detector arrays with high energy resolution and good spatial resolution. The goal of this development project is to produce high energy resolution mercuric iodide (HgI/sub 2/) detector sub-modules, consisting of several elements. These sub-modules can later be grouped into larger arrays of 100-400 elements. A prototype 5 element HgI/sub 2/ array detector was constructed and tested. Dimensions of each element were 7.3 mm x 0.7 mm. An energy resolution of 335 eV (FWHM) for Mn0Kα at 5.9 keV has been measured. The novel fiber-optic pulsed light feedback has been introduced into the charge preamplifiers in order to minimize electronic crosstalk between channels.

41122 **A 20 mK temperature sensor.** Wang, N.; Sadoulet, B.; Shutt, T.; Beeman, J.; Haller, E.E.; Lange, A.; Park, I.; Ross, R.; Stanton, C.; Steiner, H. (Dept. of Physics, Dept. of Material Science and Mineral Engineering, Lawrence Berkeley Lab., Univ. of California, Berkeley, CA (US)). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* **35**: No. 1, 55-58(Feb 1988). (CONF-871006—).

From 34. nuclear science symposium and 19. nuclear power systems symposium; San Francisco, CA, USA (21 Oct 1987).

The authors are developing a 20mK temperature sensor made of neutron transmutation doped (NTD) germanium for use as a phonon detector in a dark matter search. They find that NTD germanium thermistors around 20 mK have resistances which are a strong function of temperature, and have sufficient sensitivity to eventually reach a base line rms energy fluctuation of 6eV at 25 mK. Further work is needed to understand the extreme sensitivity of the thermistors to bias power.

4404 Well Logging Instrumentation

REFER ALSO TO CITATION(S) 41612

41123 **(LA—11327-MS) Initial borehole acoustic televiewer data processing algorithms.** Moore, T.K. (Los Alamos National Lab., NM (USA)). Jun 1988. Contract W-7405-ENG-36. 178p. NTIS, PC A09/MF A01; 1; GPO Dep. Order Number DE88012950/JAW.

With the development of a new digital televiewer, several algorithms have been developed in support of off-line data processing. This report describes the initial set of utilities developed to support data handling as well as data display. Functional descriptions, implementation details, and instructions for use of the seven algorithms are provided. 5 refs., 33 figs., 1 tab.

45 EXPLOSIONS AND EXPLOSIVES

4501 Chemical

REFER ALSO TO CITATION(S) 40593, 40735, 40736

41124 **(AD-A—190989/4/XAB) Structural response of ship-stiffened panel at Event MINOR SCALE.** Slater, J.E.; Houlston, R.; Ritzel, D.V. (Defence Research Establishment Suffield, Ralston, Alberta (Canada)). Jan 1988. 66p. (DRES—485). NTIS, PC A04/MF A01.

Modern computational methods and experimental test procedures are being developed to determine more accurately the air-blast loading and dynamic response of naval ship structures subjected to weapon explosions. Previously, a series of air-blast trials on full-scale stiffened panels typical of those used in warship superstructures had been conducted for conventional-scale weapons (under 454 kg HE) to evaluate new design and damage-assessment techniques. This report describes the experimental results and the associated numerical study of the panel response for a longer-duration loading generated by the simulation of an 8-kiloton nuclear-weapon surface explosion called MINOR SCALE. The panel, exposed to a side-on overpressure blast loading of 345-kPa peak and 200-ms positive duration, experienced only slight permanent deformation of about 25 mm with no apparent weld or buckling failure. The measured pressure, strain, acceleration, and displacement data correlated well with the computed numerical results, thus verifying the computational methods.

41125 **(AD-A—191570/1/XAB) Design concept for a large-scale test bed for large blast/thermal simulator research. Final report, 1 October 1986-21 January 1987.** Evans, J.L.; Griffin, C.L.; Guislain, S.J.; Laverentz, H.D.; Pilgrim, J.M. (Battelle Columbus Labs., Research Triangle Park, NC (USA)). Nov 1987. 96p. NTIS, PC A05/MF A01.

The feasibility of installing a new compressed-gas driver at the existing BRL Shock Tube Facility is examined. The new driver would be three feet in diameter, 80 feet long, and would be installed in the space now occupied by the existing eight foot diameter driver. The new driver would be capable of holding an internal pressure of 1,760 psi and would be equipped with electric-strip heaters to control the temperature of stored gas at 325 to 650 K. A nitrogen gas pressurization system would be used with the new driver. The report concludes that the facility modifications are feasible and outlines specific alterations needed. Construction costs were estimated to be about $1.1 million, and construction time was estimated to be 8 to 10 months.

41126 **(LA-SUB—651-2C-1) Shock initiation of explosives with a sensitive rate and related topics: Final report.** Stewart, D.S. (Los Alamos National Lab., NM (USA); Illinois Univ., Urbana (USA). Dept. of Theoretical and Applied Mechanics). [1988]. Contract W-7405-ENG-36. 13p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88008483/JAW.

The aim of the research has been to provide a complete, rational, theoretical description of the process of detonation initiation, either by a shock or due to the growth of embedded "hot spots" (reaction centers) in a preconditioned explosive which has a sensitive, state-dependent reaction rate. A representative experiment that these studies model is that of piston driven shock initiation. In order to study the process in detail, a systematic asymptotic analysis of the reactive Euler equations with Arrhenius reaction-rate kinetics has been carried out. Through a combination of large activation energy asymptotics and numerics on sets of reduced equations, these studies have given a precise description of the distinct stages of the initiation event prior to the emergence of a full-fledged detonation: induction, localized thermal runaway, thermal explosion at the runaway site, and the birth of a supersonic reaction wave (a

constant-volume detonation!) propagating through an inertially confined medium. 2 figs.

41127 **(SAND—87-3019C) Hermetic G-16 percussion primer.** Durand, N.A.; Weinmaster, R.R.; Massis, T.M. (Sandia National Labs., Albuquerque, NM (USA)). 1988. Contract AC04-76DP00789. 11p. (CONF-880750—5; CONF-880750—). NTIS, PC A02/MF A01;1; GPO Dep. Order Number DE88009261/JAW.

From 13. international pyrotechnics seminar; Grand Junction, CO, USA (11 Jul 1988).

Studies were conducted to optimize a Hermetic percussion primer capable of surviving temperatures of 200{degree}C for up to 48 hours. These studies included work with typical brass percussion primers and the pyrotechnic composition designed G-16. The G-16 mixture is composed of antimony sulfide, calcium silicide, and potassium. The hermetically sealed assembly consists of a brass cup and anvil loaded with G-16 pyrotechnic mixture and assembly includes a steel disc which is laser welded over the sealing mechanisms cause negligible changes. This assembly can be used with other primers and is capable of enhanced output for specialized applications. 4 refs., 8 figs., 4 tabs.

41128 **(SAND—88-7094C) Thermodynamic analysis of TiH/sub x//$KClO_4$ combustion in a closed system.** Razani, A.; Shahinpoor, M. (New Mexico Univ., Albuquerque (USA). Dept. of Mechanical Engineering). 1988. Contract AC04-76DP00789. 16p. (CONF-880750—10). NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88011793/JAW.

From 13. international pyrotechnics seminar; Grand Junction, CO, USA (11 Jul 1988).

The combustion of TiH/sub x//$KClO_4$ in a closed system with densities of 50 to 85 percent of the theoretical void free density is investigated. The thermodynamic properties are determined assuming equilibrium conditions using the TIGER computer program. Assuming complete combustion of the TiH/sub x//$KClO_4$ and a constant volume for the closed system, the calculated results indicate an equilibrium pressure that increases with the TiH/sub x//$KClO_4$ density. The high equilibrium pressures that were calculated suggested that accurate equations of state must be used; therefore the effect of different equations of state was investigated. As expected, the flame temperature and the concentrations of the combustion product species are not strong functions of the TiH/sub x//$KClO_4$ density. The calculated temperature of the gaseous products of combustion is close to the isochoric flame temperature. This is due to the fact that the heat loss from the combustion products is neglected and the system is assumed to initially have a negligible amount of gas present. The equilibrium pressure is an important parameter in determining the burning rate of TiH/sub x//$KClO_4$ in both the conductive and convective modes. In the conductive mode, the heat feedback from gaseous combustion products depends on the pressure and in the convective mode, both the flow of combustion products into the pores and the heat feedback are pressure dependent. 16 refs., 3 figs., 6 tabs.

41129 **(SAND—88-8001) Combustion of energetic materials: Semi annual progress report, April-September 1987.** (Sandia National Labs., Livermore, CA (USA)). 1988. Contract AC04-76DP00789. 45p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88011286/JAW.

Our program emphasizes fundamental research and is directed towards understanding the combustion, chemistry and physics of energetic solids and liquids. Experimental effort consists of the following: (1) solid propellant thermal decomposition and deflagration studies and (2) liquid monopropellant ignition and combustion studies. A gas-flame experiment designed to model the two-stage flame characteristics of solid propellant deflagration has been established and both conventional and laser diagnostics have been incorporated into it. Thermal decomposition (using laser heating) of solid propellants is being studied using a modulated molecular beam mass spectrometer that will be complemented by laser-induced fluorescence diagnostics. Gas-phase flame models used previously for hydrocarbon flame analysis are being extended to study gas-phase reactions in nitramine propellants. Quantum chemistry calculations are being performed to investigate the molecular decomposition mechanisms of energetic materials. Solid propellant deflagration is being modeled analytically and through the use of two-dimensional thermochemical codes developed earlier for related research programs. Droplet combustion models developed for hydrocarbon fuels are being extended for liquid monopropellant applications. 43 refs., 40 figs., 2 tabs.

4502 Nuclear

REFER ALSO TO CITATION(S) 39620, 39631, 39796, 41499

41130 **(AD-A—189738/8/XAB) Target Detection Routine (TADER). user's guide. Final report.** Bauman, W.J. (Army Concepts Analysis Agency, Bethesda, MD (USA)). Sep 1987. 137p. (CAA-D—87-8). NTIS, PC A07/MF A01.

Documentation was prepared for the Target Detection Routine (TADER) developed at the US Army Concepts Analysis Agency. TADER was designed to compute the probability of operational target acquisition (POTA) of generic military units scanned by opposing sensor arrays over a fixed search period. Computed POTA values are input to a CAA nuclear fire planning model (NUFAM). TADER is a deterministic model that employs an input target lucrativeness threshold to filter out detections not suitable for targeting. The TADER User's Guide is structured to provide a user with sufficient information on model input/output and operation to effectively apply TADER. Additional information on TADER model logic may be found in the TADER Methodology Description (CAA-TP-87-9), published separately.

41131 **(AD-A—189769/3/XAB) Target Detection Routine (TADER) methodology description. Final report.** Bauman, W.J.; Penn, S.L. (Army Concepts Analysis Agency, Bethesda, MD (USA)). Sep 1987. 139p. (CAA-TP—87-9). NTIS, PC A07/MF A01.

Documentation was prepared for the Target Detection Routine (TADER) developed at the US Army Concepts Analysis Agency. TADER was designed to compute the probability of operational target acquisition (POTA) of generic military units scanned by opposing sensor arrays over a fixed search period. Computed POTA values are input to a CAA nuclear fire planning model (NUFAM). TADER is deterministic model that employs an input target lucrativeness threshold to filter out detections not suitable for targeting. The TADER Methodology Description is structured to provide a user with detailed information of TADER model logic. Additional information on TADER model operation may be found in the TADER User's Guide (CAA-D-87-8), published separately.

41132 **(AD-A—190837/5/XAB) NATO and the neutron bomb: necessity or extravagance.** Nell, P.A. (Army Command and General Staff Coll., Fort Leavenworth, KS (USA). School of Advanced Military Studies). 4 Dec 1987. 61p. NTIS, PC A04/MF A01.

Considerable controversy and fierce political and military debate has surrounded the development and potential employment of tactical battlefield nuclear weapons. This paper seeks to trace the historical evolution of these weapons, with specific emphasis upon the enhanced radiation (ER) family of tactical nuclear arms. This approach is useful because so little is actually known about ER weapons as compared to their conventional-nuclear-weapons counterparts. Discussions address the capabilities and characteristics of nuclear and ER Weapons with an associated analysis of the Soviet-Warsaw Pact threat that currently faces NATO and western Europe. It was this specific threat that proved to be the driving force that initially prompted the US to develop a tactical ER nuclear capability. The paper also addresses the current array of US tactical nuclear weapons, with emphasis upon specific systems and NATO stockpile data. Finally, an analysis of employing this weapon is explored with respect to current Army nuclear weapons doctrine, systems capability, and enemy threat. This culminating discussion demonstrates that it has been, and continues to be, in our best interest to retain the present strategy option of preemptive use of enhanced radiation and tactical nuclear weapons should the NATO battlefield commander be faced with no other alternative to avoid defeat.

41133 **(AD-A—190900/1/XAB) DNA SCILS (Survivable Command Information and Liaison System) program. Technical report, 30 November 1982-30 May 1986.** Gordon, G.A. (R and D Associates, Marina del Rey, CA (USA)). 30 May 1986. 50p. (RDA-TR—125300-005). NTIS, PC A03/MF A01.

The SCILS program investigates and demonstrates concepts of operation for dispersed theater forces C3. The dispersal concept would increase the number of potential targets for nuclear strike, make these targets smaller, more highly mobile and harder to find, and introduce functional redundancy. The SCILS system is a microcomputer-based approach to preserving and enhancing the effectiveness of C3 operation in a dispersed configuration. In this program, the system was implemented for testing for the 9th Infantry Division in coordination with the Army's Distributed Command and Control System. Technical highlights of the system include a distributed, replicated data base, a video map/graphics-oriented Commander's Decision Display System, a packet switched Multi-Media Network that operates with deployed field communication systems, and a Voice/Data Conferencing System that supports remote coordination/briefing in a dispersed configuration. The program and resulting system are discussed in this report.

41134 **(AD-A—191291/4/XAB) Spacecraft charging effects on satellites following STARFISH Event.** (Computer Sciences Corp., El Segundo, CA (USA)). 17 Feb 1978. 46p. NTIS, PC A03/MF A01.

The purpose of this effort is to review spacecraft performance immediately before and after the STARFISH high-altitude nuclear test to determine whether the artificial electron environment produced by the nuclear burst may have caused any discernible spacecraft (S/C) charging effects either through satellite telemetry or through data channels of on-board experiments.

41135 **(AD-A—191488/6/XAB) Update of Soviet research on and exploitation of nuclear winter, 1984-1986. Technical report, 1 June 1984-16 September 1986.** Goure, L. (Science Applications International Corp., McLean, VA (USA)). 16 Sep 1986. 74p. (SAIC—86/1866). NTIS, PC A04/MF A01.

The analysis of Soviet source materials shows that Soviet scientists have made only minimal contributions to nuclear winter research and that much of the published work has continued to be based on worst-case war scenarios, parameters and values, and projection of climatic changes derived from seriously flawed 1983 models and computations in the U.S. and Soviet Union. For political and propaganda reasons, most Soviet open sources on nuclear winter have continued to ignore new Western and even some Soviet projections of more-moderate climatic effects. It appears that Soviet efforts to model nuclear winter have run their course and that more emphasis will be placed on the synergistic effects of nuclear war on the ecology and atmosphere.

41136 **(AD-A—192056/0/XAB) Early smoke plume and cloud formation by large-area fires. Technical report, 15 November 1984-29 May 1987.** Heikes, K.E.; Ransohoff, L.M.; Small, R.D. (Pacific-Sierra Research Corp., Los Angeles, CA (USA)). 29 May 1987. 92p. (PSR—1728). NTIS, PC A05/MF A01.

It is likely that a nuclear burst over an urban area would cause a large number of fires burning simultaneously over hundreds of square kilometers. The atmospheric heating produced by these fires would result in low-level convergence over a broad region and a highly buoyant upward mass flux over the fire, lofting large quantities of smoke and moisture to high altitudes. This report presents the results of highly resolved numerical calculations describing the early-time cloud and smoke-plume formation by large city fires. The simulations show that atmospheric moisture contributes significantly to plume evolution through latent heat release. The model indicates that early scavenging of smoke particles by precipitation is likely to reduce the amount of smoke injected into the upper atmosphere. A principal result is that plume rise is controlled primarily by fire intensity and atmospheric stratification rather than fire size.

41137 **(AD-A—192212/9/XAB) Forward and inverse modeling of near-field seismic waveforms from underground nuclear explosions for effective source functions and structure parameters. Final report, 5 September 1986-5 March 1987.** Burdick, L.J.; Barker, J.S. (Woodward-Clyde Consultants, Pasadena, CA (USA)). 5 Apr 1987. 127p. (WCCP-R—87-01). NTIS, PC A07/MF A01.

It is well established that near-field records of nuclear explosions can be analyzed to obtain detailed information about the seismic source function and its dependence on yield. This information is generally formulated in terms of parametrized models for the RDP and for the test-site crustal structure. In this study, results of forward modeling studies are reviewed to obtain the source and structure parameters for Pahute Mesa. These models fit the observed near-field records well, but there is some question as to how errors in crustal structure might affect seismic-source parameters. Furthermore, there is a general need to be able to develop source-structure models in a consistent, unbiased fashion. To address these issues, a simultaneous inversion was developed for source and structure parameters. In previous reports, the authors discussed the development of the method and applied it to Pahute Mesa data. This report presents an application of an improved technique for inverting for parameters in these types of problems known as the jumping method. A second problem with analysis of near-field records from explosions is that there is some question as to whether crustal materials respond in a linear anelastic or anelastic fashion or whether they have significant nonlinear response because of the high-shear strain levels. Near-field data sets from several nuclear explosions and an earthquake are examined to address this question. It is shown that if nonlinear material response occurs it does not have a large enough effect to have a significant effect on data interpretation.

41138 **(AD-A—955334/8/XAB) Mighty EPIC instrumentation summary.** (Defense Nuclear Agency, Kirtland AFB, NM (USA). Test Directorate). Sep 1976. 145p. NTIS, PC A07/MF A01.

Science Applications, Incorporated (SAI) fielded two experiments on the Mighty Epic Event: (1) a Neutron Time-of-Flight (NTOF) experiment that made nine measurements of neutron fluence as a function of time; and (2) a Fast Spectral experiment that made 18 x-ray-fluence measurements as a function of spectral energy, plus two gamma-flux measurements. Data were recorded on oscilloscopes in ROSES 004, located in the ROSES drift, and in alcove 1-4 near station 2. Digital data were generated in ROSES 004, transmitted to trailer 12039, in the mesa trailer park, and stored on magnetic recording tape. Excellent data were recorded on all channels. The NTOF data were particularly noise-free which had not been the case on several previous tests. The clean data can be attributed to revised system grounding techniques and the use of short-signal cable runs to the ROSES.

41139 **(AD-A—955335/5/XAB) Minutes of the Husky Pup prefielding instrumentation meeting held on 28-29 April 1975 at Kirtland AFB, New Mexico.** (Defense Nuclear Agency, Kirtland AFB, NM (USA). Test Directorate). 26 Feb 1976. 206p. NTIS, PC A10/MF A01.

Contents include: output diagnostics, neutron time-of-flight, energy coupling; particle velocity; energy-coupling stress measurement; energy-coupling shock time of arrival and containment diagnostics; free-field stress with memory and post-event interrogation; USN RB systems and materials studies; output diagnostics; containment diagnostic and materials phenomenology; output diagnostics and materials studies; materials phenomenology; closure monitors; and tunnel-environment measurements.

41140 **(ORAU—88/B-85) Review of SCOPE 28 report on environmental consequences of nuclear war: Volume 2, Ecological and agricultural effects: Science panel report No. 5.** (Committee on Interagency Radiation Research and Policy Coordination, Washington, DC (USA)). Mar 1988. Contract AC05-76OR00033. 70p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE88012978/JAW.

The panel's simulation studies and analysis of recent literature led to conclusions concerning the effect of atmospheric pertur-

bations on crop production. Crop growing in the mid-latitudes of the Northern Hemisphere could be totally destroyed or production severely reduced for at least the first growing season after a nuclear exchange, if the resulting atmospheric perturbations were to cause temperature decreases on the order of 5 to 15{degree}C for even short periods of time. Other conclusions were: Animal contributions to human food would be worthless for some period. Radioactive fallout could result in severe contamination of some areas and impair normal farming operations. Destruction of dams and disruptions of electricity supplies in a nuclear exchange could remove large areas of irrigated agricultural land from production for many years and greatly reduce postwar agricultural productivity. Destruction of the complex agricultural infrastructure would likely result in total elimination of food supplies to a major portion of the survivors of a nuclear exchange.

41141 **(UCID—21295) Lawrence Livermore National Laboratory cavity pressure measurements and gas sampling for MISSION GHOST.** Sisemore, C.; Hudson, B.; Cordill, C.; Smith, C. (Lawrence Livermore National Lab., CA (USA)). 24 Sep 1987. Contract W-7405-ENG-48. 28p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88012446/JAW.

A cavity pressure and gas sampling experiment was fielded for the MISSION GHOST event. Six pressure and sampling tubes were emplaced: three for cavity pressure and three for gas sampling. The tubes were wound in the form of a helix with a pitch chosen to balance axial compression and tension along each tube as the cavity grew and the surrounding medium was displaced. The hardware was placed in the U121.09 tunnel on May 18 and 19, 1987. Over the next four weeks the experimental apparatus was assembled, checked out, and certified. System monitoring and dry runs were begun during this time and continued until shot day on June 20, 1987. The gas sampling system operated for about 4 hr and acquired five gas samples. Unfortunately, these samples did not contain radioactive constituents. Subsequent samples were collected during re-entry activities, and good quality cavity gas was obtained from the 09RE{number<-sign}1 drill hole. The cavity pressure system was monitored for about 2000 hr after the event and produced good pressure data during that time. 13 figs., 3 tabs.

41142 **(UCRL—53813) Alaskan frozen soil impact tests of the B83-C/S and Strategic Earth Penetrator.** Dockery, H.A.; Clarke, J.B.; Stull, S.P. (eds.); Cain, S.G.; Everett, R.N.; Flower, E.C.; Huntting, J.D.; Spencer, C.R.; Todaro, A.F.; Vidlak, A.J. (Lawrence Livermore National Lab., CA (USA)). 1 Oct 1987. Contract W-7405-ENG-48. 25p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88002517/JAW.

To assess the penetrability of the B83 strategic bomb and a Strategic Earth Penetrator design into frozen soil and ice, Lawrence Livermore National Laboratory and Sandia National Laboratories, assisted by the US Air Force and US Army, conducted a series of tests in 1987. In April, Strategic Earth Penetrator units were dropped into multi-year sea ice and frozen tundra near Prudhoe Bay, Alaska. Calculated impact velocity ranged from 200 to 308 ft/s into ice and from 200 to 444 ft/s into frozen tundra. Tests in May include drops of a B83 design with specially designed ogive nose shape, a B83 with a cap over the production "cookie cutter" nose, and a Strategic Earth Penetrator. The May tests were conducted near Fairbanks, Alaska, at Eielson Air Force Base and at Donnelly Flats on the Fort Greely Military Reservation. The type of frozen soil encountered at Eielson was very homogeneous in composition; however. Two drops impacted areas with very thin frozen soil layers at depths of about 24 in. below the surface. Velocities of these drops prior to impact ranged from 256 to 308 ft/s, and peak axial deceleration ranged from 160 to 490 g. The units penetrated to depths of 7.5-12 ft. Three other events impacted in a target area where frozen soil averaging 35 in. thick extended essentially to the surface. We calculated velocities prior to impact at 200-256 ft/s; and penetration depths of 3.2-9.6 ft. The geologic material at Donnelly Flats was primarily a very hard, rocky glacial deposit with a variable degree of ice bonding. Here, the test units dropped from 10,000 ft above ground level and achieved an average calculated velocity of 802 ft/s. Depth of penetration ranged from 7.6 to 13.5 ft.

41143 **(UCRL—96354) CORNUCOPIA cavity pressure measurement.** Hudson, B.; Cordill, C.; Starrh, L.; Kalinowski, J.; Stubbs, T.; Keller, C.; Peterson, E.; Nilson, R. (Lawrence Livermore National Lab., CA (USA); EG and G Energy Measurements, Inc., Pleasanton, CA (USA); Science and Engineering Associates, Santa Fe, NM (USA); S-Cubed, La Jolla, CA (USA)). Oct 1987. Contract W-7405-ENG-48. 30p. (CONF-870961—9).

From 4. symposium on containment of underground nuclear explosions; Colorado Springs, CO, USA (21 Sep 1987).

Many attempts have been made to measure cavity pressure over the past 25 years, but almost all have failed. A cavity-pressure measurement experiment was fielded on the CORNUCOPIA event. Electrical cables extended from a recording facility to an experiment package located deep in the emplacement hole, but not so deep as to be subjected to damaging stress levels from the outgoing shock wave. The experiment package contained high-pressure tanks, valves, and pressure transducers. A set of three stainless-steel tubes (approximately 0.25 in. O.D. {times} 0.15 in. I.D.) extended from the experimental package to the detonation elevation. These tubes were wound in the form of a helix with a pitch chosen such that as the cavity grew and the surrounding medium was displaced, axial compression and tension along the axis of each tube would balance. In addition, each tube was filled with water to prevent collapse from the high stresses (up to hundreds of kbars) in the ground shock wave. Within the experimental package each water-filled tube was connected to a high-pressure tank filled with dry nitrogen at about 12,000 psia. A few seconds before detonation, explosively driven valves were opened, pressurizing the water-filled tubes. Shortly after detonation, the strong shock wave vaporized and/or melted the end of each tube, allowing the pressurized water to be blown out. The experiment performed very well, giving a complete pressure history for each of three independent sets of tube, transducer, and recording channels, from a few seconds before detonation until cavity collapse, approximately nine hours later.

4503 Explosion Detection

REFER ALSO TO CITATION(S) 40024, 41621

41144 **(AD-A—190577/7/XAB) Approximation technique for solving a system of Fredholm integral equations for asymmetric detector response functions. Master's thesis.** Daniel, R.B. (Air Force Inst. of Tech., Wright-Patterson AFB, OH (USA). School of Engineering). Mar 1988. 150p. (AFIT/GNE/ENG—88M-3). NTIS, PC A07/MF A01.

The purpose of this study was to develop the methodology for and to implement a computer program to approximate a solution to a system of Fredholm integral equations. The system of equations used in this study is representative of the equations formed during the detection of pulsed radiation using a series of detectors with asymmetric response functions. Though general in nature and applicable to all systems of Fredholm integral equations, the equations studied are of importance to the Defense Nuclear Agency with regard to the measurement of radiation spectra during underground nuclear effects simulation testing. The deconvolution or solution technique consisted of representing the unfolded spectrum as a weighted sum of basis functions. This unfolded spectrum, the actual spectrum, and predicted spectrum were then used to form a chi square test statistic. By adjusting the parameters in the basis functions and their weights, chi square was minimized and the unfolded spectrum was corrected to approximate the actual spectrum. The methodology for this deconvolution technique was then converted into a general computer program. The validation cases conducted on the two types of spectra confirmed the reliability of the methodology and the computer program.

41145 **(UCID—21409) LOCKNEY (U19aq) interaction with KERNVILLE (U20ar) ground motion and structural response measurements.** Burdick, R.B.; Stavnheim, B.L.; Weaver, H.J. (Lawrence Livermore National Lab., CA (USA)). 1 May 1988. Contract W-7405-ENG-48. 65p. NTIS, PC A04;3. Order Number DE88010731/JAW.

Accurate ground motion and structural response predictions are central capabilities to the successful fielding of nuclear tests by

Lawerence Livermore National Laboratory. The Nuclear Test Engineering Division in support of the Nuclear Test Program has been given the responsibility for making these predictions. Ground motions resulting from the firing of one event can have a serious impact on the safety, location and scheduling of other events at the Nevada Test Site. Currently, the methods used to predict ground motion and thereby, structural response, are empirically based. It is therefore critical, that actual ground motions and structural responses be monitored for comparison with the predictions. This report documents the findings resulting from the LOCKNEY event interacting with the KERNVILLE event. This interaction was unique in that it was the first time a canister had been left suspended from the Ringer Crane during a predicted Class 3 interaction. Ground motions are examined in the time domain for comparison with predictions. Ground motions are also examined in the frequency domain. The spectral content of the interaction signal is important when attempting to make structural response predictions. No spectral information is incorporated in our present response predictions. In addition to ground motion evaluation, the structural responses of some key components at the KERNVILLE ground zero are evaluated. Finally, summaries and conclusions are presented. 15 refs., 23 figs., 9 tabs.

50 ENVIRONMENTAL SCIENCES, ATMOSPHERIC

REFER ALSO TO CITATION(S) 40009

41146 (IC—87/395) Method for predicting monthly rainfall patterns. Njau, E.C. (International Centre for Theoretical Physics, Trieste (Italy)). Nov 1987. 33p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703005/JAW.

A brief survey is made of previous methods that have been used to predict rainfall trends or drought spells in different parts of the earth. The basic methodologies or theoretical strategies used in these methods are compared with contents of a recent theory of Sun-Weather/Climate links (Njau, 1985a; 1985b; 1986; 1987a; 1987b; 1987c) which point towards the possibility of practical climatic predictions. It is shown that not only is the theoretical basis of each of these methodologies or strategies fully incorporated into the above-named theory, but also this theory may be used to develop a technique by which future monthly rainfall patterns can be predicted in further and finer details. We describe the latter technique and then illustrate its workability by means of predictions made on monthly rainfall patterns in some East African meteorological stations. (author). 43 refs, 11 figs, 2 tabs.

41147 (IC—87/407) Correlation between the time-series of air temperature and incident solar radiation at Port Harcourt, Nigeria. Adjepong, S.K.; Okujagu, C. (International Centre for Theoretical Physics, Trieste (Italy)). Dec 1987. 7p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88703009/JAW.

We present the preliminary results of an investigation of the correlation between the temporal variations of the time-series of ground air temperature and incident solar radiation recorded at Port Harcourt (lat. 4 deg. 51′ N, long. 7 deg. 01′ E), Nigeria, during a five-year period (1981 through 1985). Computed cross-correlation functions of the daily time-series reveal correlation at time lags which are approximate harmonics of the 27-day solar rotation cycle. The cross-correlation function of the mean monthly series shows correlation at a time lag of 12 months implying a dominant annual-cycle component in the variation of either series. (author). 12 refs, 2 figs.

5001 Basic Studies

REFER ALSO TO CITATION(S) 41628

41148 (CEA-DAS—279e) Design basis for the operational modelling of the atmospheric dispersion. Doury, A. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. d'Analyse de Surete). Oct 1987. 18p. (EN;FR). (CONF-860803—). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88752403/JAW.

From 7. world clean air congress and exhibition; Sydney, Australia (25 Aug 1986).

Based on the latest practices at the Institut de Protection et de Surete Nucleaire of the Commissariat a l'Energie Atomique (CEA), we shall first present the basis elements used for a simple and adequate modelling method for assessing hypothetical atmospheric pollution from transient or continuous discharge with any given kinetics under various weather conditions which are not necessarily stationary or uniform, which are likely to occur even with little or no wind. Discharges shall be considered as sequences of instantaneous successive puffs. The parameters deduced experimentally or from observations are functions of the transfer time and cover all time and space scales. The restrictions of use are indicated, especially concerning heavy gases. Finally, simple formulas are proposed for concentrations and depositions so as to be able to make a rapid estimation of the orders of magnitude with almost no computation.

41149 (DL—929901) CO/sub 2/ climate literature review. Phase 1. Carbon cycle and the biosphere. Summary report. (Dillon (M.M.) Ltd., Ottawa, Ontario (Canada)). Mar 1983. 40p. (CE—01604). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

The purpose of this review is to summarize the role of the terrestrial components of the biosphere (forests, wetlands, tundra, soils, grasslands) and fresh-water aquatic components (river, lakes and marshes) in the carbon cycle, particularly as they relate to the atmospheric concentration of CO/sub 2/. Where possible, carbon sinks, sources and transfers have been indicated quantitatively. Canadian data have been stressed in the review, notably with respect to the role of Canadian biomass in the carbon cycle. 69 refs., 3 tabs.

41150 (GKSS—87/E/55) Moisture height profiler. Voss, E.; Riebesell, M.; Lahmann, W.; Weitkamp, C.; Michaelis, W. (GKSS-Forschungszentrum Geesthacht G.m.b.H., Geesthacht-Tesperhude (Germany, F.R.); GKSS-Forschungszentrum Geesthacht G.m.b.H., Geesthacht-Tesperhude (Germany, F.R.). Inst. fuer Physik). 1987. 7p. (CONF-8703222—). Reprint from: Lutz, H.; Otrio, G. (eds.): Proceedings - SPIE Vol. 810 - Optical systems for space applications. Society of Photo-Optical Instrumentation Engineers, Bellingham, WA (USA), 1987 p. 37-41.

From Optical systems for space applications; The Hague, Netherlands (30 Mar 1987).

The paper describes a ground-based Raman lidar for the measurement of vertical concentration profiles of tropospheric water vapor. The system will also be used to assess the feasibility of carbon dioxide profile determination. The main components are a xenon chloride excimer laser, reflective 0.4-m transmitter and 0.8-m receiver optics, liquid edge filter for suppression of the Rayleigh and Mie scattered photons, and an echelle grating polychromator for wavelength separation. The data acquisition is done by a fast multichannel scaler. The apparatus is described, and first moisture measurements up to a vertical distance of 3 km taken in less than 2 minutes with a spatial resolution of 120 m are presented. (orig.)

41151 (LBL—24893) Smoke emission factors from medium scale fires: Part 2. Dod, R.L.; Brown, N.J.; Mowrer, F.W.; Novakov, T.; Williamson, R.B. (Lawrence Berkeley Lab., CA (USA)). Apr 1988. Contract AC03-76SF00098. 21p. (CONF-871055—6-Pt.2). NTIS, PC A03;3. Order Number DE88010776/JAW.

From 3. international conference on carbonaceous particles in the atmosphere; Berkeley, CA, USA (5 Oct 1987).

Smoke emmission factors, (i.e.; the mass of smoke per mass of fuel burned), were measured in eleven separate experiments. The size distribution of the smoke particles was determined using a cascade impactor. The percentages of "black" carbon (also called "graphitic" or "elemental" carbon) and organic carbon have been determined for all the experiments as a function of particle aerodynamic diameter. Values in the range of .1 to .2% are reported for the smoke particle emission factors for Douglas fire whole wood and plywood burning under well ventilated conditions. Approximately 65% of the particles have aerodynamic diameters less than 1 μm. Douglas fir whole wood gave smoke emission factors in the range of 2 to 3.5% when burned under poorly ventilated conditions representative of a building fire that is limited by air entrainment. For this case the size distribution was much broader, with substantial quantities of particles up to 5 μm aerodynamic diameter. For all experiments, the black carbon content represented between 50 and 75% of the total mass of the smoke particles. The smoke emission factor for burning asphalt roofing shingles is reported as 12.1% with black carbon content greater than 70%. Over half of the mass consisted of particles of less than 1 μm aerodynamic diameter.

41152 **(PB—88-202015/XAB) ECC (electrochemical concentration cell) ozonesonde observations at South Pole, Antarctica, during 1987. Data report.** Komhyr, W.D.; Franchois, P.R.; Kuester, S.E.; Reitelback, P.J.; Fanning, M.L. (National Oceanic and Atmospheric Administration, Silver Spring, MD (USA). Air Resources Lab.). Mar 1988. 326p. (NOAA-DR-ERL-ARL—15). NTIS, PC A15/MF A01.

Atmospheric ozone vertical distributions, air temperatures, and wind speed and wind direction data are presented for 76 balloon electrochemical concentration cell (ECC) ozonesonde soundings made at South Pole, Antarctica, in 1987.

41153 **(UCRL—98779) Global climatic effects of a nuclear war: An interdisciplinary problem.** Ghan, S.J. (Lawrence Livermore National Lab., CA (USA)). May 1988. Contract W-7405-ENG-48. 6p. (CONF-8805138—1). Unlimited audience, publicly available.;1; GPO Dep. Order Number DE88011738/JAW.

From NATO symposium on climate and geo-sciences; Louvain-la-Neuve, Belgium (22 May 1988).

In summary, an elucidation of the global-scale response to a nuclear war is a problem of great breadth, involving many of the sub-disciplines of aerosol physics, meteorology, oceanography, atmospheric chemistry and ecology. As diverse as these fields are, communication between the sub-disciplines has been remarkably effective, with two major interdisciplinary reports published in the last few years. It is my belief that, in addition to addressing the global-scale implications of a nuclear war, the global effects effort also serves as an excellent example of an interdisciplinary research program. 23 refs.

41154 **Diurnal variability of the planetary albedo: An appraisal with satellite measurements and general circulation models.** Potter, G.L.; Cess, R.D.; Minnis, P.; Harrison, E.F.; Ramanathan, V. (Lawrence Livermore National Laboratory, University of California, Livermore, California). *Journal of Climate;* 1: No. 3, 233-239(Mar 1988).

This study addresses two aspects of the planetary albedo's diurnal cycle, the first of which refers to directional models of the planetary albedo. It is found that even for clear regions there appear to be deficiencies in our knowledge of how to model this quantity. Over land surfaces, for example, Nimbus-7 data for the directional planetary albedo compare best with model calculations for which a Lambertian surface is assumed, despite ample evidence that the albedo of land surfaces is dependent upon solar zenith angle. Similarly, over ocean surfaces both GOES and Nimbus-7 data produce a weaker dependence of the planetary albedo upon solar zenith angle than would be suggested by model calculations.

5002 Chemicals Monitoring And Transport

REFER ALSO TO CITATION(S) 39094, 39100, 39106, 39152, 39175, 39234, 39777, 40007, 40011, 40012, 40123, 40215, 40231, 40232, 40233, 40270, 40429, 40488, 40508, 40545, 40769, 41149, 41354, 41356, 41359, 41485, 41582

41155 **(AD-A—192053/7/XAB) Aircraft emissions characterization: TF41-a2, TF30-p103, and TF30-p109 engines. Final report, December 1985-March 1987.** Spicer, C.W.; Holdren, M.W.; Miller, S.E.; Smith, D.L.; Smith, R.N. (Battelle Columbus Labs., OH (USA)). Dec 1987. 76p. NTIS, PC A05/MF A01.

Assessment of the environmental impact of aircraft operations is required by Air Force regulations. This program was undertaken with the aim of quantifying the gaseous and particulate emissions associated with three Air Force turbine engines. These engines were TF41-A2, TF30-P103, and TF30-P109. The emissions tests were carried out, using a test cell Tinker AFP, Oklahoma City, OK. All tests employed JP-4 as the fuel, and fuel samples were characterized by standard tests and analyzed for composition. Emissions were measured at power settings of idle, 30%, 75%, 100%, and afterburner (where appropriate). Measurements were made of detailed organic composition, CO, CO_2, NO, NOx, smoke number, particle concentration, and particle-size distribution. A multiport sampling rake was used to sample the exhaust, and heated Teflon tubing was used to transfer exhaust to the monitoring instrumentation. Measured and calculated fuel/air ratios were compared to assure representative sampling of the exhaust.

41156 **(AD-A—192209/5/XAB) User's manual for ADAM (Air Force Dispersion Assessment Model). Volume 2. Final report, 22 January 1986-21 December 1987.** Raj, P.K.; Morris, J.A. (Technology and Management Systems, Inc., Burlington, MA (USA)). 21 Dec 1987. 21p. NTIS, PC A03/MF A01.

The Air Force Dispersion Assessment Model (ADAM) (described in Volume I of this report) is implemented in FORTRAN in a computer program. This Volume describes what computers the program will run on, how to install the program on the computer, and how to use the model. Figures and Tables are used to illustrate the computer-program operation. The models are coded in the computer program in FORTRAN; the graphics output is coded in FORTRAN with FORTRAN-compatible HALO graphics macros for screen graphics. The complete program is designed to run on the Air Force's Zenith microcomputer. The model runs in under five minutes.

41157 **(ANL/EES-TM—335-Vol.1) Estimated monthly emissions of sulfur dioxide, oxides of nitrogen, and volatile organic compounds for the 48 contiguous states, 1985-86: Volume 1, interim update and methodology review.** Kohout, E.J.; Knudson, D.A.; Saricks, C.L.; Miller, D.J. (Argonne National Lab., IL (USA)). Jun 1987. Contract W-31109-ENG-38. 185p. NTIS, PC A09/MF A01;1; GPO Dep. Order Number DE88012401/JAW.

The purpose of this report is threefold. First, it reports recent trends in sulfur dioxide (SO_2) and oxides of nitrogen (NO/sub x/) emissions. This work is part of a continuing study of the seasonal and regional patterns of these pollutants. An earlier Argonne National Laboratory (ANL) report, estimated Monthly Emissions of Sulfur Dioxide and Oxides of Nitrogen for the 48 Contiguous States, 1975-1984, presented estimates of NO/sub x/ and SO_2 emissions that were developed for each month by state. This report extends the NO/sub x/ and SO_2 series to 1985 and 1986. In addition, emission estimates are introduced for a new class of pollutants, volatile organic compounds (VOCs). The VOC estimates are given for 1985 and 1986 by month and state. Second, this report discusses how the estimating methodology used in this update differs from that used in the previous report. Third, this report examines areas in which the methodology could be improved. Changes in the methodology and improvements in the data sources could result in more accurate and efficient estimates of pollution emissions. 20 refs., 13 figs., 2 tabs.

41158 **(ANL/EES-TM—335-Vol.2) Estimated monthly emissions of sulfur dioxide, oxides of nitrogen, and volatile organic compounds for the 48 contiguous states, 1985-1986: Volume 2, Sectoral emissions by month for states.** Kohout, E.J.; Knudson, D.A.; Saricks, C.L.; Miller, D.J. (Argonne National Lab., IL (USA)). Nov 1987. Contract W-31109-ENG-38. 142p. NTIS, PC A07/MF A01;1; GPO Dep. Order Number DE88012402/JAW.

A listing by source of sulfur dioxide, nitrogen oxides and volatile organic compounds emitted in 48 states of the US is provided. (CBS)

41159 **(ANL/EES-TM—345-Vol.1) In pursuit of clean air: A data book of problems and strategies at the state level, 1987 update: Volume 1: Federal regions I through V.** Loughe, A. F.; Gerry, P. A.; Streets, D. G. (Argonne National Lab., Idaho Falls, ID (USA)). Dec 1987. Contract W-31109-ENG-38. 379p. NTIS, PC A17/MF A01;1; GPO Dep. Order Number DE88011589/JAW.

To address these concerns, this report updates data on nonattainment areas, SIP attainment strategies, and other air-quality-related items as of December 31, 1987. The two volumes present state-level information about nonattainment designations, SIPs for nonattainment areas, a list and map of PSD areas, tables of general SO_2 and particulate matter emission limits, as well as a list of unit-specific SO_2 SIP limits for utility generating plants. The volumes are organized by federal region, with Regions I-V in Volume 1 and Regions VI-X in Volume 2. The summary material presented in Sections 1-5 of this text portion is repeated at the beginning of each volume. Section 1 is this introduction; Section 2 provides maps of US counties containing nonattainment areas and summarizes attainment progress; Section 3 addresses the status of SIP submissions; Section 4 reviews the PSD program; Section 5 addresses future regulatory and legislative actions regarding attainment of the NAAQS; and Section 6 describes in detail the data for each state. 13 refs., 7 figs., 11 tabs.

41160 **(AQR—041988) Controlling U.S. acid gas emissions: options to meet Canada's needs.** Jessup, P. (Air Quality Research, Toronto, Ontario (Canada)). Apr 1988. 34p. (CE—01657). Energy Probe, 100 College Street, Toronto, Ont., Canada M5G 1L5; $10.00 CAN.

This report describes results of a study of the Canada/USA transborder acid gas pollution problem and possible Canadian policies to deal with USA's contribution to the problem. Central to the study is a survey of emissions from over 400 midwest USA power plant boilers, attempting to identify the technologies most suitable for controlling these plants' sulfur emissions and to quantify the costs of using these technologies. A midwestern sulfur dioxide abatement program aimed at reducing acid gas emmisions by 50-67% from 1985 would cost the USA about $6-12 billion in capital expenses, if the least-cost strategy described in the analysis is employed. Such an effort would be close in effectiveness to what a moderate national acid rain law would achieve, and the cost would be less than that spent on facilities to clean up the Great Lakes from 1973-84. Scrubbers would be the most cost-effective way to reduce emissions on the large boilers which produce most of the region's emissions. Eventual commercialization of one class of clean coal technologies, i.e. retrofit systems, could be even more cost effective. The most effective first step would be to employ conventional scrubbers targeted at those midwestern boilers that emit the most acid gas. Implementation of this strategy is legislatively possible under the existing US Clean Air Act, which also has a transboundary provision. Such strategies encouraged by Canada and cooperating northeast states could be the basis for significant emissions reduction in the few states that contribute most to acid rain in Canada, at only a fraction of the cost of a national US acid rain control program. 5 refs., 7 figs., 5 tabs.

41161 **(BNL—52122) A statistical study of the macroepidemiology of air pollution and total mortality.** Lipfert, F.W.; Malone, R.G.; Daum, M.L.; Mendell, N.R.; Yang, Chin-Chun. (Brookhaven National Lab., Upton, NY (USA)). Apr 1988. Contract AC02-76CH00016. 143p. NTIS, PC A07/MF A01;1; GPO Dep. Order Number DE88012934/JAW.

A statistical analysis of spatial patterns of 1980 US urban total mortality (all causes) was performed, evaluating demographic, socioeconomic and air pollution factors as predictors. Specific mortality predictors included cigarette smoking, drinking water hardness, heating fuel use, and 1978-1982 annual concentrations of the following air pollutants: ozone, carbon monoxide, sulfate aerosol, particulate concentrations of lead, iron, cadmium, manganese, vanadium, as well as total and fine particle mass concentrations from the inhalable particulate network (dichotomous samplers). In addition, estimates of sulfur dioxide, oxides of nitrogen, and sulfate aerosol were made for each city using the ASTRAP long-range transport diffusion model, and entered into the analysis as independent variables. Because the number of cities with valid air quality and water hardness data varied considerably by pollutant, it was necessary to consider several different data sets, ranging from 48 to 952 cities. The relatively strong associations (ca. 5--10%) shown for 1980 pollution with 1980 total mortality are generally not confirmed by independent studies, for example, in Europe. In addition, the US studies did not find those pollutants with known adverse health effects at the concentrations in question (such as ozone or CO) to be associated with mortality. The question of causality vs. circumstantial association must therefore be regarded as still unresolved. 59 refs., 20 figs., 40 tabs.

41162 **(BNL—52152) 1987 environmental monitoring report.** Miltenberger, R.P.; Royce, B.A.; Naidu, J.R. (eds.). (Brookhaven National Lab., Upton, NY (USA)). Apr 1988. Contract AC02-76CH00016. 141p. NTIS, PC A07/MF A01;1; GPO Dep. Order Number DE88013621/JAW.

The primary purpose of Brookhaven National Laboratory's (BNL) environmental monitoring program is to determine whether: facility operations, waste treatment, and control systems functioned as designed to contain environmental pollutants; and the applicable environmental standards and effluents control requirements were met. This annual report for calendar year 1987 follows the recommendations given by the Department of Energy (DOE) but has been broadened to meet site-specific environmental monitoring needs. This program includes the sampling and analysis for radioactivity, water quality indices, metals, and organic compounds. 32 refs., 17 figs., 70 tabs.

41163 (CONF-871075—Vol.1-Pt.1, pp 291-306) **Replacement of chlorinated solvents at the Oak Ridge Y-12 Plant.** Thompson, L.M.; Simandl, R.F.; Richards, H.L. (Martin Marietta Energy Systems, Inc., Oak Ridge, TN (USA)). Oct 1987. NTIS, PC A15/MF A01. Order Number DE88007803/JAW. Contract AC05-84OR21400.

From 3. Oak Ridge model conference on waste problems; Oak Ridge, TN, USA (13 Oct 1987).

Due to environmental and health concerns, both EPA and OSHA have announced their intent to further restrict the use of chlorinated solvents. In order to comply with these upcoming regulations, the Oak Ridge Y-12 Plant is conducting a survey on the use of these solvents and possible alternatives. The main use of these solvents has been found to be for cleaning purposes. This includes vapor degreasing as well as squirt bottle usage for removal of machining oils and coolants. One alternative which has been successful is the use of ultrasonic cleaning with aqueous detergents. Several studies have been conducted using X-ray Photoelectron Spectroscopy (XPS/ESCA) to evaluate the surface cleanliness and the effect of this cleaning technique on the surface chemistry. Studies have also been conducted to optimize various factors which influence this cleaning technique. Although this technique has been useful in several areas, some problem areas still exist with replacing chlorinated solvents. These areas are currently being addressed and will continue to be addressed in the future.

41164 **(CONF-880186—1) Effects on aquatic systems: Discussion of major criticisms.** Turner, R.S. (Oak Ridge National Lab., TN (USA)). 1988. Contract AC05-84OR21400. 13p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88011863/JAW.

From International conference on acidic precipitation: a technical amplification of NAPAP's findings: Air Pollution Control Association technical conference; Pittsburgh, PA, USA (26 Jan 1988).

This report is an edited transcript of a panel discussion covering the effects of acid rain on aquatic systems. Topics centered on

selecting a pH value at which biological effects become evident, the role of inorganic aluminium as an indicator of an acid lake, and the level of changes in an acid lake. (TEM)

41165 **(CONF-8704291—1) Estimating the reliability of regional predictions of aquatic effects of acid deposition.** Gardner, R.H.; Hettelingh, J.P.; Kaemaeri, J.; Bartell, S.M. (Oak Ridge National Lab., TN (USA); International Inst. for Applied Systems Analysis, Laxenburg (Austria); National Board of Waters, Helsinki (Finland)). 1987. Contract AC05-84OR21400. 44p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88009703/JAW.

From 2. IIASA-INGW task force meeting on atmospheric computations to access acidification in Europe; Warsaw, Poland (27 Apr 1987).

Predictions from the RAINS Lake Module (RLM) and data from Finno-Scandia are compared to identify and quantify errors associated with extrapolation of site-specific information; test and quantify our abilities to perform useful extrapolations; and establish guidelines and limits for the role of data and models in regional assessments. The results show that simple procedures can be used to calibrate the RLM and quantify the prediction errors. Sensitivity and uncertainty analysis identified SOILT (the soil-thickness of the catchment) and SIBRC (the silicate buffer rate) as the key model parameters. When SOILT and SIBRC were calibrated for region 1 of Finland the mean and variance of predicted pH values adequately matched the data. The extrapolation of these results to other regions indicates that broad geographic areas exist where errors of extrapolation have little efect on the accuracy of model predictions. Although the pattern of predictions with time can not be verified by data, the consistency of predictions indicates that net changes between future scenarios produce similar results independent of the method used to calibrate model parameters. 25 refs., 8 figs., 6 tabs.

41166 **(CONF-8708252—) Proceedings from the second science team meeting of the United States of America Department of Energy and the People's Republic of China Academia Sinica Joint Research Program on CO_2-Induced Climate Change.** (USDOE Office of Energy Research, Washington, DC. Carbon Dioxide Research Div.). Jun 1988. Contract AC01-86ER60446. 187p. NTIS, PC A09/MF A01;1; GPO Dep. Order Number DE88011540/JAW.

From 2. science team meeting of the United States DOE and Peoples Republic of China academia; Harpers Ferry, WV, USA (26 Aug 1987).

The six papers presented here as the proceedings of this second Joint CO_2 Research Team Meeting are examples of the research progress during the last two years. The first paper is documentation of the first numerical climate simulation model developed by the Institute of Atmospheric Physics in Beijing. Two papers from the National Oceanic and Atmospheric Administration's National Climatic Data Center at Asheville, North Carolina, demonstrate the work being done on the United States Historical Climatology Network data (the time series of temperature, precipitation, and sunshine) in the US. The fourth paper speaks of climate variability on a regional scale being much larger than that based on averages of global-wide data and therefore more difficult to predict. The China Precipitation Proxy Index covers a period of 510 years. This permits comparison of contemporary climate patterns (i.e., the last 100 years) with the period of the Little Ice Age when the mean temperature over China was 2{degree} colder than present. The fifth paper is fascinating documentation of the effects of climate change upon the wild elephants whose habitat has shifted from as far north as Beijing, in historical times, to a currently small, sequestered section in the southwest corner of the country. The final paper demonstrates the pragmatic exchange of both data and technical assistance between the two countries.

41167 **(DOE/ER/60422—H1) Surface energy balance of three general circulation models: Current climate and response to increasing atmospheric CO_2.** Gutowski, W.J.; Gutzler, D.S.; Portman, D.; Wang, W.C. (Atmospheric and Environmental Research, Inc., Cambridge, MA (USA)). May 1988. Contract FG02-86ER60422. 119p. (TR—042). NTIS, PC A06/MF A01;1; GPO Dep. Order Number DE88010967/JAW.

41168 **(ERCB/C—IL88-5) Application for approval of natural gas-driven compressors.** (Energy Resources Conservation Board, Calgary, Alberta (Canada)). 9 May 1988. 8p. (CE—01771). Energy Resources Conservation Board, 640-5th Ave. SW, Calgary, Alta., Canada T2P 3G4; $N/C.

Alberta Environment and the Energy Resources Conservation Board, with assistance from the Alberta Petroleum Industry-Government Environmental Committee, have completed a review of Alberta's oxides of nitrogen (NO/sub x/) emission requirement for compression facilities. As a result of this review, a number of changes were made to the design requirements for compressor stations and to the application procedures for obtaining approval to construct and operate these facilities. This information letter describes the revised application procedures for approval of compression facilities including application requirements and changes to the method of designing engine exhaust stacks, and the requirements for the use of low NO/sub x emisson engines.

41169 **(GAO/RCED—85-13) An analysis of issues concerning acid rain.** (General Accounting Office, Washington, DC (USA)). 1984. 185p. General Accounting Office, PO Box 6015, Gaithersburg, MD 20877.

GAO examines the implications of current scientific knowledge for policy decisions on acid rain and offers a series of observations on the following issues involved in the debate: to what extent has it been scientifically demonstrated that acid rain is resulting in damage to the environment? What are the causes of acid rain and where is it most prevalent? What alternatives exist for controlling acid rain and what are their economic effects?

41170 **(GAO/RCED—85-73) EPA's delegation of responsibilities to prevent significant deterioration of air quality: How is it working.** (General Accounting Office, Washington, DC (USA)). 1985. 37p. General Accounting Office, PO Box 6015, Gaithersburg, MD 20877.

GAO reviewed EPA's delegation of the Prevention of Significant Deterioration Program to six states within three EPA regions and found that EPA had taken steps to ensure that those state agencies had the legal authority, technical capabilities, and resources needed to administer the program before delegating responsibilities to them. GAO also found no significant differences in levels of effort between E*PA and those states in carrying out the program activities before and after delegation.

41171 **(GAO/RCED—85-129) EPA-approved revisions to state implementation plans allowing increased sulfur dioxide emissions were legal.** (General Accounting Office, Washington, DC (USA)). 1985. 22p. General Accounting Office, PO Box 6015, Gaithersburg, MD 20877.

GAO found that the revisions allowed a net increase of 1.5 million tons of sulfur dioxide emissions during calendar years 1981-83; that the increases in emissions would not violate national standards and, thus, were consistent with key act requirements and that EPA's approval decisions were based on some uncertainties, which EPA is currently assessing.

41172 **(GAO/RCED—86-1BR) Air pollution: Environmental Protection Agency's inspections of stationary sources.** (General Accounting Office, Washington, DC (USA)). 1984. 45p. General Accounting Office, PO Box 6015, Gaithersburg, MD 20877.

During 1984 about 95% of the stationary sources requiring inspection were inspected. GAO suggests that 39% of these were inspected inadequately. EPA is evaluating the contractor's methodology for determining the appropriate frequency and depth of inspections.

41173 **(GAO/RCED—86-170) Air pollution: Hazards of indoor radon could pose a national health problem.** (General Accounting Office, Washington, DC (USA)). 1986. 55p. General Accounting Office, PO Box 6015, Gaithersburg, MD 20877.

This report provides information on the public's exposure to and the health effects of radon; cost and alternatives for reducing

indoor radon levels; and federal efforts and statutory authorities and responsibilities to address indoor radon problems.

41174 **(GAO/RCED—87-23) Air quality standards: EPA's standard setting process should be more timely and better planned.** (General Accounting Office, Washington, DC (USA)). 1986. 41p. General Accounting Office, PO Box 6015, Gaithersburg, MD 20877.

This report examines the current status and cost of EPA's efforts in reviewing and updating the standards [on air quality mandated by the Clean Air Act] and the extent to which the standards require additional supporting research and EPA's plans for addressing these research needs.

41175 **(GAO/RCED—87-85FS) Air pollution: EPA enforcement of air quality at the Port of Stockton, California.** (General Accounting Office, Washington, DC (USA)). 1987. 10p. General Accounting Office, PO Box 6015, Gaithersburg, MD 20877.

This report summarizes the results of work concerning a long-standing controversy between the director of the Port of Stockton and the regional EPA office over whether the Port of Stockton is in compliance with air quality emissions standards. The dispute was settled in July 1986 with a consent decree.

41176 (GQ/ME—1988, pp 53-60) **The environmental impacts of emissions from residential combustion heating systems in Canada.** Kozak, J.H. (Environment Canada, Dartmouth, Nova Scotia). 1988. Environment Canada, Publications Section, Terrasses de la Chaudiere, Ottawa, Ont., Canada K1A 0H3; $N/C. (MICROLOG—88-03825; CONF-8804158—).

From 3. conference on toxic substances; Montreal, Canada (6 Apr 1988).

In general, environmental and health concerns regarding residential heating emissions have focussed on residential wood combustion (RWC). With the resurgence of wood as a residential fuel since the mid 1970s in North America, a number of ambient air and source apportionment studies associated with residential wood combustion have been conducted to measure the impacts of particulate matter (and particle size) and trace organics on air quality. Although a direct causal link cannot be established with respect to health and RWC emissions, there is enough evidence to suggest that high levels of emissions, especially of particulates could aggravate health problems among certain portions of the population. Also, enough is known about the properties of certain pollutants emitted from RWC activities to warrant action, in addition to nuisance effects reported in many localities. In Canada, potential and actual environmental problems caused by RWC are very site specific and are related to population size, appliance density, climatic and topographical variations. Potential problem areas in Canada seem to be certain areas in the Yukon, British Columbia, and certain localities in Atlantic Canada, Quebec and Ontario. With the exception of the Whitehorse Yukon case, provincial and municipal authorities have approached the woodsmoke issue on a case by case basis. In some areas, monitoring of indoor and outdoor air is required to further delineate the extent of RWC health impacts. 6 refs., 4 tabs.

41177 (GQ/ME—1988, pp 23-52) **Measurement of polycyclic aromatic hydrocarbons (PAH) in the ambient air.** Dann, T. (Environment Canada). 1988. Environment Canada, Publications Section, Terrasses de la Chaudiere, ottawa, Ont., Canada K1A 043; $N/C. (MICROLOG—88-03825; CONF-8804158—).

From 3. conference on toxic substances; Montreal, Canada (6 Apr 1988).

The category of compounds known as polycyclic aromatic hydrocarbons (PAH) have received a great deal of attention in recent years because some species of PAH are known human carcinogens. In order to establish a data base on current levels of PAH in Canadian urban areas, monitoring program has been established for PAH at sites in Toronto, Ontario and a Montreal, Quebec. This report provides a summary of the PAH data collected at the two sites. The results are discussed in terms of the sampling methodology employed and in terms of environmental significance. Measurements from the two sites are compared to results from other urban areas. The hi-vol based filter/polyurethane foam sampling system performed well during the course of the measurement program. Of the PAH compounds considered probable or possible carcinogens benzo(b,k)fluoranthene was found in the highest concentration at both sites. Sources of PAH are still poorly characterized. The use of ratios of PAH compounds to benzo(e)pyrene was not a good source identification tool in either site. A unique source of phenanthrene was indicated in both cities; because of phenanthrene's good correlation with temperature, an evaporative source was indicated. Using current estimates of carcinogenic risk associated with organic air pollutants, measured levels of benzo(e)pyrene present the highest risk of the organic compounds recently measured in both sites. This is despite the fact that benzo(e)pyrene levels have been reduced greatly over the past twenty to thirty years. As for most toxic air pollutants, the ambient air data base for PAH is very sparse. Additional long term monitoring in urban areas of Canada is required. 41 refs., 5 figs., 11 tabs.

41178 **(IEACR—07) CO_2 and climatic change.** Smith, I.M. (IEA Coal Research, London (UK)). May 1988. 52p. NTIS (US Sales Only), PC A04. Order Number TI88013152/JAW.

This review examines recent developments in the issue of a greenhouse warming due to increased concentrations of CO_2 and other trace gases in the atmosphere. Past, current and possible future trends in the emissions of the greenhouse gases are summarized. The limitations and results of models to study possible climatic changes are discussed and evidence from empirical studies appraised as a means of detecting such changes. Precautionary measures concerned with abatement and control of CO_2 emissions are outlined. These include improved energy use efficiency, substitution of energy sources as well as recycling, removal, utilisation and disposal of CO_2. It is concluded that future emissions of the greenhouse gases form one of the greatest sources of uncertainty. Climatic model results suggest that there will be a noticeable global warming in one or two decades with more uncertain regional changes. Observations are consistent with these results. An improved understanding of such climatic changes is required to provide a firmer basis for policy decisions. The scope of the report excludes the potentially detrimental or beneficial effects of a climatic warming on human welfare and hence also policies of adaptation to such changes. 167 refs., 19 figs., 13 tabs.

41179 **(OH/RD—87/240/K) Preliminary evaluations of the proposed regulation 308 modelling package.** Edwards, G.C.; Wright, S.C. (Ontario Hydro Research Div., Toronto (Canada)). 2 Oct 1987. 100p. (MICROLOG—88-01737). Ontario Hydro Research Division, Editorial Section, 800 Kipling Ave., Toronto, Ont., Canada M8Z 5S4; $10.00 CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

The proposed Ontario Environment Ministry regulation 308 air pollution disposal modelling package is composed of several models. The model used depends on site and meteorological conditions. The Environmental Science Section (ESS) Research Division has obtained these models and undertaken evaluation with a focus towards identifing inconsistencies, poor parameterizations and difficulties which may be encountered in operational use of the new models to obtain certificates of approval for fossil-fuel power plants. To implement and use the new modelling group is a much involved and complex process when compared to the procedure presently prescribed for air quality approvals. This report describes briefly the course of the ESS model evaluation work program and experience with the models to date. The report shows the new models to be approximately three times more restrictive than the present regulation model. Preliminary sensitivity tests show the models to be particularly sensitive to the inputs, stack exit temperature, stack exit velocity, wind speed and cloud cover. The model evaluations have also shown most of Ontario Hydro sources would be classified such that region multisource modelling will be required to obtain Certificates of Approval. This protocol is complex and expensive involving compilation or collection of extensive meteorological and source input data sets. 3 refs., 40 figs., 2 tabs.

41180 **(PB—88-157888/XAB) Volatile organic compound model (Version 1.8) (for microcomputers). Software.** Jennings, M.S.; Emmel, T.E.; Jones, L.G. (Environmental Protection Agency, Research Triangle Park, NC (USA). Air and Energy Engineering Research Lab.). 1988. vp. (EPA—600/8-87/059B). NTIS CP D99.

The software is contained on 5 1/4-inch diskette, double sided, double density compatible with the IBM PC/XT/AT microcomputer. Diskettes are in the ASCII format. Price includes documentation, PB—88-157896.

Future emissions of volatile organic compounds (VOCs) and costs of their control can be estimated by applying growth factors, emission constraints, control cost functions, and capacity retirement rates to the base line estimates of VOC emissions and industrial VOC source capacity in 1980. A personal computer model has been developed by the U.S. EPA to automate the forecasting procedure. The report provides guidelines for installing and operating the volatile organic compound model (VOCM) on an IBM-PC or IBM-PC compatible computer. The report describes how a VOCM user can create his own data files or use those supplied with VOCM for preparing forecasts..Software Description: The software was programmed using the PC-PASQUAL Language for implementation on the IBM-PC, XT, AT computers using the DOS 3.1 operating system and 320 K bytes memory.

41181 **(PB—88-173232/XAB) MM4 (Penn State/NCAR (National Center for Atmospheric Research)) Mesoscale Model Version 4 documentation. Technical note.** Hsie, E.Y. (National Center for Atmospheric Research, Boulder, CO (USA)). Jul 1987. 226p. (NCAR/TN—293-STR). NTIS, PC A11/MF A01.

This document describes the general program design and data organization of the PSU/NCAR Mesoscale Model Version 4(MM4). The basic model was developed in the Pennsylvania State University over the past 15 years and has undergone many changes and improvements over the last 3 years, largely as a result of increased resources made available by the Acid Deposition Modeling Project (ADMP) at NCAR. Description of the basic model structure and data organization is given in enough detail that a user can begin to add to or modify the code for his own research. In the first chapter, the general structure is outlined. Chapter 2 describes all the PARAMETER statements used in the model. Chapter 3 presents a list of all the variables in common blocks. The individual subroutines are described in Chapter 4. Finally, job-control language, the source code, and the modification deck needed are given in Chapter 5.

41182 **(PB—88-175898/XAB) Carbonaceous species methods comparison study at Citrus College. Task: analysis for trace hydrocarbons and related halocarbons in urban ambient air samples. Final report.** Rasmussen, R.A. (Oregon Graduate Center, Beaverton (USA)). Oct 1987. 26p. (OGC—55-196). NTIS, PC A03/MF A01.

As part of the ARB-sponsored Carbonaceous Species Methods Comparison Study (CSMCS) in Glendora, CA, from August 11-21, 1986, time-integrated, ambient samples were collected in stainless steel canisters. Five samples per day were collected, ranging from 4 to 8 hours according to the CSMCS protocol. The species measured included CO, CH_4, CO_2, H_2, and the C_2 through C10 hydrocarbons. In addition, N_2O, the halocarbons F-12, F-11, F-113, $CHCl_3$, CH_3CCl_3, CCl_4, C_2HCl_3 and C_2Cl_4 were measured. Four gas-chromatograph systems were used to quantify these species. The report contains tables of concentrations of the species measured at the South Coast Air Basin site during smoggy summer conditions.

41183 **(PB—88-179239/XAB) Air-chemistry studies over the Gulf of Mexico: a bilateral scientific cooperative project between the United States of America and the United States of Mexico. Technical memo.** Parungo, F.; Miller, J. (National Oceanic and Atmospheric Administration, Boulder, CO (USA). Environmental Sciences Group). Feb 1988. 254p. (NOAA-TM-ERL-ESG—29). NTIS, PC A12/MF A01.

This report documents the scientific research of a bilateral cooperative project between the United States of America and The United States of America. In 1986 scientists from both nations joined a research cruise in the Gulf of Mexico to investigate the air chemistry over the water that the two nations share. Emphases were placed on natural air quality, anthropogenic air pollution, acid rain, air-sea-land exchanges of gases and aerosols. The investigation included in-situ measurements and post-cruise laboratory analyses. Chemical, physical, meteorological, and oceanographic analyses were conducted to survey temporal and spatial variations of diverse parameters throughout the Gulf. The data sets were analyzed, interpreted, and intercorrelated. The results show that during the cruise (20 July-22 August), the large-scale air trajectories were easterly from the Caribbean Sea at all levels; however, the Gulf air measured was highly polluted in general.

41184 **(PB—88-182019/XAB) User's guide to the Offshore and Coastal Dispersion (OCD) Model; (revised 1988).** Hanna, S.R.; Schulman, L.L.; Paine, R.J.; Pleim, J.E. (Environmental Research and Technology, Inc., Concord, MA (USA)). 1988. 534p. NTIS, PC A23/MF A01.

For system on magnetic tape, see PB—88-182019.

The Offshore Coastal Dispersion (OCD) Model was adapted from the EPA guideline model MPTER to simulate the effect of offshore emissions from point sources in coastal regions. Modifications were made to incorporate overwater plume transport and dispersion as well as changes that occur as the plume crosses the shoreline. Hourly meteorological data are needed from overwater and overland locations. Turbulence intensities are used but are not mandatory. For overwater dispersion, the turbulence intensities are parameterized from boundary-layer similarity relationships if they are not measured.

41185 **(PB—88-186242/XAB) Dust in a food-mixture factory. An investigation to dust exposure and effects on lungs and bronchial tubes.** Groenendijk, A.; Lumens, M.; Smid, T.; Heederik, D.; Marquart, H. (Wageningen Gezondheidsleer (Netherlands)). Nov 1987. 81p. (In Dutch). (REPT—1987-308). NTIS, PC E04/MF A01.

41186 **(PB—88-188321/XAB) Health hazard evaluation report HETA 87-171-1840, New Jersey Department of Transportation, Trenton, New Jersey.** Mehta, M.; Liveright, T.; Dawkins, S. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). Oct 1987. 32p. (HETA—87-171-1840). NTIS, PC A03/MF A01.

In response to a request from the Communication Workers of America Local 1032, an investigation of skin rash, sore throat, headache, runny nose, watery eyes, and inability to use contact lenses was made at the New Jersey Department of Transportation in Trenton, New Jersey. Air was sampled for formaldehyde, volatile organic compounds, carbon dioxide, carbon monoxide, ammonia, relative humidity, and dry-bulb temperature. An evaluation was made of the heating, ventilating, and air-conditioning system. The highest formaldehyde level was 0.094 parts per million (ppm), just below the American Society of Heating, Refrigerating, and Air Conditioning Engineers recommended level (0.097ppm). Carbon dioxide levels were 400 to 1100ppm. Volume of outdoor air at three air handling units was 5 to 79 cubic feet/minute/person. Relative humidity was 28 to 34%; New Jersey Department of Health recommended 40 to 60%. Of 1200 employees, 828 completed questionnaires about health status and nature and extent of building-related complaints to pinpoint problem areas. While workers on the second and seventh floors had the most symptoms and complaints, there was no association between symptoms and any measurements taken. Recommendations include lowering indoor air temperature, which might result in decreased formaldehyde levels, complete assessment of the building-ventilation system, increase in amount of outdoor air supplied, and increase in humidity levels.

41187 **(PB—88-188339/XAB) Health-hazard evaluation report HETA 86-251-1842. American Cyanamid, Michigan City, Indiana.** Almaguer, D. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). Oct 1987. 17p. (HETA—86-251-1842). NTIS, PC A03/MF A01.

In response to a request from the International Chemical Workers Union, an evaluation was made of employee exposures to nickel at the American Cyanamid Company, Michigan City, Indi-

ana, which produced petroleum-industry catalysts. Employee exposures to metals and dusts, including 28 elements of toxicological importance, were evaluated during an industrial hygiene survey involving personal and general air sampling. Each of the 11 air samples showed aluminum, molybdenum, and nickel, while some showed calcium, cobalt, copper, iron, magnesium, and zinc. The only metal exceeding NIOSH Recommended Exposure Limit (REL) was nickel, ranging from 0.004 to 0.29mg/cu m (REL, 0.015mg/cu m). Dust concentrations were below the American Conference of Governmental Industrial Hygienists threshold limit value of 10mg/cu m for nuisance dusts, ranging from 0.61 to 5.69mg/cu m. Concentrations of nickel precluded considering these as nuisance dusts and further reduction in amounts should be made. The author recommends that care be taken to ensure good working order of mullers to prevent leaks. Generation of nickel dusts in impregnation area should be better controlled. A regular housekeeping schedule should be started for vacuum removal of accumulated dust from work areas. Appropriate respirators should be worn in muller room and impregnation and product load out areas.

41188 **(PB—88-188362/XAB) Health-hazard evaluation report HETA 86-206-1744, Rotorex, Walkersville, Maryland.** Kerndt, P.R.; Sinks, T.H.; Wallingford, K.M. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). Oct 1986. 43p. (HETA—86-206-1744). NTIS, PC A03/MF A01.

In response to a labor/management request, an evaluation was made of sudden illness in workers at the Rotorex facility in Walkersville, Maryland, employing about 350 workers. The facility had been closed after an explosion on January 29, 1986, due to a malfunctioning boiler-regulator valve. After reopening on February 3, ten employees became ill with headaches, nausea, dizziness, and chest pain. Eight were tested for carbon-monoxide (CO) blood levels; five had elevated carboxyhemoglobin (COHb) levels. Another outbreak occurred on February 19, with 18 employees removed by stretcher. Tests for CO, trichloroethylene (TCE), fluorocarbons, and methylene chloride exposure were negative. The authors conclude that illness on February 3 was due to combined CO and TCE exposures; illness on February 19 was an anxiety reaction. It is recommended that a joint management/union health and safety committee be formed that meets regularly, with easy employee access. Development of evacuation procedures, evaluation of ventilation systems, study of welding and brazing operations for hazardous substances, determination of oil mist levels, weekly bacterial check of central coolant, evaluation of Freon-11 use in open cans, study of noise exposure, and replacement of a welding curtain are additional recommendations.

41189 **(PB—88-188388/XAB) Health-hazard evaluation report HETA 85-159-1827, Blackman Uhler Chemical Company (Synalloy Corporation), Spartanburg, South Carolina.** Zey, J.N.; Singal, M.; Smith, A.B.; Caplan, P.E. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). Aug 1987. 35p. (HETA—85-159-1827). NTIS, PC A03/MF A01.

In response to a confidential request, evaluation was made of bladder cancer incidence among workers at Blackman Uhler Chemical Company, Spartanburg, South Carolina. Short-term air samples were collected for dimethylformamide, ortho-dianisidine, and chromium (VI). Five of six samples showed no detectable levels of these compounds; the sixth showed a level of dimethylformamide well below OSHA permissible exposure limits. Deficiencies were noted in chemical-handling procedures, work practices, engineering controls, and employee training and education regarding safety practices. There was a medical screening program for bladder cancer at the facility, but 689 of the 919 current and former employees had not participated. One case had been identified as of April 1985. It is suggested that there may be undetected cases of bladder cancer. It is recommended that better education of employees be undertaken concerning chemicals with which they work; that work practices be modified; that respiratory protection be improved with emphasis on selection, cleaning and maintenance, fit testing, and proper storage of protective equipment; that emergency showers and eye baths be inspected regularly; that labels be properly placed on tanks; that the screening program for medical problems continue to be available to all current and former workers; and that special medical evaluation be performed for any employee with urinary tract symptoms, microhematuria, or nonnegative cytology.

41190 **(PB—88-188396/XAB) Health-hazard evaluation report HETA 85-107-1841, General Electric Company, Schenectady, New York.** Gorman, R.; Rinsky, R.; Moseley, C. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). Oct 1987. 21p. (HETA—85-107-1841). NTIS, PC A03/MF A01.

In response to a request from the International Union of Electrical Workers, employee exposure to chemicals and possible work-related illnesses and deaths were examined in the wind stand area of Building 273 of the General Electric facility, Schenectady, New York. In the area of the facility, epoxy-resin coatings were applied to surfaces of large steam-turbine-generator stators twice a year. Review of records and interviews of 19 employees neither supported nor refuted claims of work-related disease or death. It was noted that a large number of chemicals were present in the area and that there was poor product labelling on containers. Air samples taken during application of epoxy resin coatings did not reveal the presence of components such as bisphenol-A and its diglycidyl-ether, epichlorohydrin, or organic vapors, with the exception of Propasol-Solvent-P which contained propoxypropanol isomers. Air samples of the last compound ranged from 7.4 to 31.0mg/cu m in each of four breathing-zone samples. The chemical was reported to be an irritant and central nervous system depressant, but no exposure limit had been set. The authors conclude that no health hazard exists. They recommend that antifogging chemical splash goggles be worn during the epoxy process in addition to other protective gear already in use. Close monitoring is recommended, particularly in winter when ventilation would be poor. Employees should be encouraged to report illnesses to the company medical director.

41191 **(PB—88-188404/XAB) Health-hazard evaluation report HETA 85-064-1844, GTE/Valenite Corporation, Westminster, South Carolina.** Bryant, C.J.; Rondinelli, R.; Singal, M. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). Oct 1987. 28p. (HETA—85-064-1844). NTIS, PC A03/MF A01.

In response to a confidential request, an evaluation of exposure to hard-metal dusts was made at GTE/VALENITE Corporation (SIC-3541), Westminster, South Carolina, employing 50 production workers. Dusts were generated during finish grinding of tungsten carbide cutting tool inserts. Personal and area air samples were analyzed for seven nitrosamines, cobalt, and tungsten. No nitrosamines were detected. Cobalt levels were nondetectable to 26.8 micrograms/cubic meter (microg/m^3) (American Conference of Governmental Industrial Hygienists Threshold Limit Value, 50 microg/m^3). Tungsten levels were nondetectable to 0.41 mg/m^3 (NIOSH Recommended Exposure Limit, 5 mg/m^3). Medical survey of 35 workers showed respiratory symptoms associated with length of employment and smoking status. Symptoms did not correlate with exposure category. Personal air samples were taken for cobalt for ten workers giving urine samples pre and post shift. All had increased urine cobalt levels over shift. There was no correlation between total airborne and urine cobalt levels, but there was a significant association for post shift urinary and respirable cobalt. The authors recommend that air sampling for tungsten carbide and cobalt be continued. Good housekeeping and personal hygiene practices should be instituted and maintained. Change to a safer cutting fluid is recommended along with a medical surveillance program and careful follow up of employees with persistent symptoms of cough, chest tightness, shortness of breath, or wheezing.

41192 **(PB—88-188610/XAB) In-depth survey report: evaluation of brake drum service controls at United States Postal Service Vehicle Maintenance Facility, Louisville, Kentucky.** Cooper, T.C.; Sheehy, J.W.; O'Brien, D.M.; McGlothlin, J.D.; Todd, W.F. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). Dec 1987. 35p. (ECTB—152-11B). NTIS, PC A03/MF A01.

A control technology assessment of various methods to control worker exposure to asbestos during brake repair was reported for the Vehicle Maintenance Facility at the U.S. Post Office Build-

ing in Louisville, Kentucky. Results indicated that effective control of asbestos dust was achieved with the system used; one of 22 samples had a detectable level. Recommendations for better work practices were presented.

41193 **(PB—88-188651/XAB) Request for assistance in preventing vision disturbances and acute physical distress due to dimethylethylamine (DMEA) exposure.** (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). Dec 1987. 12p. (DHHS/PUB/NIOSH—88-103). NTIS, PC A03/MF A01.

Methods were sought to reduce exposure to dimethylethylamine (DMEA) among foundry owners, operators, and workers and manufacturers of polyamides, due to possible vision disturbances and acute physical distress which may result. An investigation was made at an aluminum-casting foundry where blurring, fogging, and halo visual disturbances had been reported among workers exposed to DMEA, along with headaches, nausea, stomach pain, and increased heart rate. Medical and environmental studies were made. Exposure concentrations causing effects were measured at equal to or greater than 6 mg/cu m, or 2 parts per million (ppm), 8 hour time-weighted average. Exposures as high as 29 mg/cu m, (9.7 ppm) for 15 minutes also may have caused adverse effects. There was no current permissible exposure limit for DMEA. Leakage around pressure-tight seals in corebox machine gaskets may have accounted for some excessive exposure. It was recommended that more-frequent maintenance of these gaskets be undertaken along with other engineering controls. Work practices should be adjusted so as to reduce the pressure that delivers DMEA to coreboxes and to avoid excess gaseous DMEA in the corebox machine. Protective gloves should be worn. Evacuation plans should be developed in the event of a spill, leak, or other serious accident that may cause high concentrations of DMEA in the workplace.

41194 **(PB—88-188800/XAB) Minimizing worker exposure during solid sampling: a strategy for effective control technology.** Wang, C.C.K. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA). Div. of Physical Sciences and Engineering). Dec 1983. 30p. NTIS, PC A03/MF A01.

A strategy for controlling worker exposures to hazardous materials during solid sampling is described. This involved a systematic approach to selecting sampling devices and peripheral control technology that would minimize hazards to workers during sample collection and still meet requirements for the sample to be usable. Primary types of sample extraction designs included cross cutting, gravity flow, auger, and retractable tube.

41195 **(PB—88-189022/XAB) National Ambient Volatile Organic Compounds (VOCS) data base, 1970-1987 (for microcomputers), Data file.** Shah, J.J.; Cupitt, L.T. (Environmental Protection Agency, Research Triangle Park, NC (USA). Atmospheric Sciences Research Lab.). 1987. vp. NTIS CP D07.

The data file is contained on 5 1/4-inch, double sided, high density diskettes, compatible with the IBM PC, AT microcomputer. The diskettes are in the dBase III PLUS (DOS BACKUP) format. Price includes documentation, PB—88-195631.

The National Ambient Volatile Organic Compounds (VOCs) Data Base update is the result of an ongoing effort to gather, evaluate, and compile the measured concentrations of a large number of VOCs. Data on the observed concentrations of 320 volatile organic compounds (VOCs) were compiled, critically evaluated, and assembled into a relational data base. Ambient (outdoor) measurements, indoor data, and data collected with personal monitors are included. The data are primarily from the period 1970-1987 and for locations within the United States. In order to compile data from many different sources, each concentration record in the data base represents the daily average for a single chemical, wherever feasible. The total data base contains more than 175,000 concentration records. The data have been assembled into a relational data base using dBASE III Plus, a commercially available data base management program. The data base is available on IBM PC-compatible diskettes. The available report contains a complete description of the data base files and a guide describing the use of a prepared program for searching and maintaining the data base. The data base consists of 42 files and requires 19.4 Megabytes of storage space.

41196 **(PB—88-189451/XAB) In-depth survey report: control technology for asbestos removal at Bloom Middle School, Cincinnati, Ohio.** Hollett, B.A.; Caplan, P.E.; Cooper, T.C.; Froehlich, P.A. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). Jun 1987. 51p. (ECTB—147-19C). NTIS, PC A04/MF A01.

The effectiveness of various controls used by the asbestos-abatement industry to control asbestos contamination at its source was evaluated. The glove-bag control method to prevent exposure in workplaces was used during the removal of asbestos pipe lagging from the Bloom Middle School, Cincinnati, Ohio by I and F Corporation. The removal contract required about 1800 linear feet of asbestos pipe lagging to be removed from 15 major rooms and areas of the building. General operation included initial site clean-up, clearance of all movable materials, and site isolation by sealing off all access with plastic sheeting taped to windows, air vents, and doors. Two entrance and egress contamination-control facilities were established. Materials to be removed were wetted as they were removed from structures they covered, and wet debris was collected and removed from the area. Workers wore protective clothing and respiratory protective equipment.

41197 **(PB—88-190780/XAB) Measurement of the mass-accommodation coefficient of SO_2(g) on water droplets.** Gardner, J.A.; Watson, L.R.; Adewuyi, Y.G.; Davidovits, P.; Zahniser, M.S. (Boston Coll., Chestnut Hill, MA (USA). Dept. of Chemistry). 1987. 11p. NTIS, PC A03/MF A01.

Pub. in Jnl. of Geophysical Research, Vol. 92, No. D9, 10887-10895(Sep 1987).

Heterogeneous reaction pathways involving water droplets in clouds and fogs are important mechanisms for chemical transformation of atmospheric trace gases. One of the fundamental parameters which determines the transfer rate of gases into aqueous droplets is the mass accommodation or sticking coefficient for gas molecules on the droplet surfaces. The authors have developed a laboratory method for directly determining mass accommodation coefficients (y) and have applied it to SO_2. The measurement indicates that SO_2 transport into clean aqueous cloud and fog droplets will not be limited by interfacial mass transport under normal atmospheric conditions.

41198 **(PB—88-191424/XAB) Computer data base from EPA's (Environmental Protection Agency's) complex-terrain field studies. Description of a SAS (Statistical Analysis System) computer data base from tracer field studies at Cinder Cone Butte, Idaho; Hogback Ridge, New Mexico; and the Tracy Power Plant, Nevada. Final report.** Truppi, L.E. (Environmental Protection Agency, Research Triangle Park, NC (USA). Atmospheric Sciences Research Lab.). Apr 1988. 176p. (EPA—600/8-88/067). NTIS, PC A09/MF A01.

As part of EPA's effort to develop and demonstrate a reliable model of atmospheric dispersion in mountainous terrain, the Complex Terrain Model Development Program was initiated. Three tracer field studies were designed to test model estimates of plume impaction with observed tracer concentration. The first study was conducted at Cinder Cone Butte, Idaho; the second at the Tracy Power Plant, Nevada. The report describes a special computer data base that uses SAS (Statistical Analysis System) software to store meteorological and tracer-gas data from the three tracer field studies. Using the self-documentation feature of SAS data sets, data variables can be quickly inspected and acquired for SAS software programming. Tables give a complete listing of all data variables along with a short descriptive label.

41199 **(PB—88-191853/XAB) Assessing the risks of trace gases that can modify the stratosphere. Volume 2: Chapters 1-5.** Hoffman, J.S. (Environmental Protection Agency, Washington, DC (USA). Office of Air and Radiation). Dec 1987. 283p. (EPA—400/1-87/001B). NTIS, PC A13/MF A01.

See also Volume 3, PB—88-191861.

This risk assessment seeks to summarize the state of scientific knowledge so that a considered judgement can be made about the need for additional controls. Scientific evidence is therefore reviewed and evaluated for two purposes: (1) to assess the likelihood

that different human activities could alter the stratosphere in ways that altered ultraviolet radiation reaching earth's surface or that changed climate; and (2) to assess the likelihood that changes in ultraviolet radiation or climate due to modifications in column ozone or stratospheric water vapor would have detrimental effects on human health or welfare.

41200 **(PB—88-191861/XAB) Assessing the risks of trace gases that can modify the stratosphere. Volume 3: Chapters 6-18.** Hoffman, J.S. (Environmental Protection Agency, Washington, DC (USA). Office of Air and Radiation). Dec 1987. 566p. (EPA—400/1-87/001C). NTIS, PC A24/MF A01.

See also Volume 2, PB—88-191853, and Volume 5, PB—88-191879.

The document examines the human health, environmental, and atmospheric risks associated with a decrease in stratospheric ozone.

41201 **(PB—88-191879/XAB) Assessing the risks of trace gases that can modify the stratosphere. Volume 5. Appendix B.** Tirpak, D.A. (Environmental Protection Agency, Washington, DC (USA). Office of Air and Radiation). Dec 1987. 159p. (EPA—400/1-87/001E). NTIS, PC A08/MF A01.

See also Volume 3, PB—88-191861.

This report is a summary integration and interpretation of the current scientific understanding of the effects of potential global climate change in the areas of forest and vegetation, agriculture, water resources, and human health. The appendix is a multi-authored review of the scientific literature on the effects of global climate change. Direct effects of CO_2 are generally not included because they have been recently reviewed elsewhere. The document was designed to provide supplementary information for use by the Environmental Protection Agency (EPA) as it assesses the impact of chemicals on the stratospheric ozone layer.

41202 **(PB—88-192091/XAB) Statistics on smoke and sulfur dioxide pollution in South Africa. Period: October 1982 to September 1984. Special report.** Kemeny, E.; Walker, N.; Ellerbeck, R. (Council for Scientific and Industrial Research, Pretoria (South Africa)). Dec 1984. 61p. (ATMOS—84/25). NTIS, PC E06/MF E06.

Summary in Afrikaans; North American Continent sales only.

During the period October 1982 to September 1984, the national network on smoke and sulfur dioxide in South Africa gained six smoke and four SO_2 monitoring sites. The number of monitoring sites that supplied data is slightly smaller than in previous years with smoke being measured at 121 sites in 30 cities and towns, and sulfur dioxide being measured at 82 sites in 18 cities and towns. The monitoring work was carried out by either the Health or the Engineering Departments of the respective cities and towns and, as far as the sampling site SCIENTIA SOUTH in the grounds of the Council for Scientific and Industrial Research in Pretoria is concerned, by the Atmospheric Sciences Division of the National Physical Research Laboratory. As in the last report, the tables Concentrations of smoke/sulfur dioxide present the monthly, yearly, and seasonal average concentrations, maximum concentrations, and frequency distributions, while the tables Long-term trends in smoke/sulfur dioxide pollution give (1) the information on the trends prevailing from the beginning of the surveys until the end of the winter season 1984, and (2) the pertinent statistical data and trends for the five winter periods 1980 to 1984, to make an assessment of the present pollution situation possible.

41203 **(PB—88-193057/XAB) Atmospheric nitrogen oxides: their detection and chemistry. Third-year report. Annual report, September 1985-December 1986.** Davis, D.; Bradshaw, J.; Rodgers, M.; Sandholm, S.; Dorris, S. (Georgia Inst. of Tech., Atlanta (USA). School of Geophysical Sciences). 1987. 129p. NTIS, PC A07/MF A01.

See also PB—87-219374.

Instrument development activity during the third-year study was focused on the detection of NO_2, HNO_3 and NO_3. A third-generation NO_2/NO sensor, capable of measuring NO and NO_2 simultaneously, was developed and fully tested both for ground-based and airborne field-sampling operations. An in-situ photofragmentation LIF HNO_3 was also successfully developed and was used to collect the first HNO_3 data for urban Atlanta. Significant progress was also achieved in the development of a long-path differential absorption (LPDA) NO_3 system. Three major field studies and one major laboratory investigation were also completed: (1) additional nighttime NO measurements at a field station outside Atlanta; (2) field measurements of HNO_3 in urban Atlanta; (3) airborne measurements of NO/NO_2 over marine and continental terrain at both high altitudes and within the boundary layer; and (4) laboratory measurements to establish the potential importance of corona discharge in the generation of NOx within electrified clouds.

41204 **(PB—88-193065/XAB) Studies of the mechanisms and rates with which nitrogen species are incorporated into cloud water and precipitation. Final report.** Hegg, D.A.; Hobbs, P.V. (Washington Univ., Seattle (USA). Dept. of Atmospheric Sciences). Dec 1987. 56p. NTIS, PC A04/MF A01.

See also PB—87-180360, and PB—85-144350.

There were 3 main scientific objectives for the third-year work: to examine the relationship between nitrate production and nitrate precursor reactants; to establish a data base on PAN, including vertical profiles in the atmosphere, which could be used to assess the transport and scavenging of PAN by precipitating systems; and to use a rainband chemistry model to quantify the fluxes of odd-nitrogen species thru precipitating systems. During the third-year study, additional data sets to pursue these objectives were obtained by piggy-backing measurements of nitrogen species on the Genesis of Atlantic Lows Experiment (GALE) field study.

41205 **(PB—88-193636/XAB) Measurement of NOx dry deposition. Final report.** Evilsizor, B.; Stedman, D.H.; Stocker, D.W. (Denver Univ., CO (USA). Dept. of Chemistry). Jun 1987. 35p. NTIS, PC A03/MF A01.

See also PB—85-241982.

This study was undertaken to investigate dry deposition to a field of growing winter wheat at a field site in Eastern Colorado. From mid-January to the end of May 1986, the CRC supported the University of Denver's participation in a cooperative field study at the Rybicka farm field site. The study represents the first time an NOx flux intercomparison was conducted by more than a single investigator. It is also the first time a statistically significant set of long-term NO and NOx flux data was taken over a wide range of meteorological and surface conditions at a homogeneous site with minimal confounding influences of local roads. Wind components, temperature, NOx, NO, NO_2 and O_3 concentrations were continuously monitored. Consistent diurnal trends in the NOx concentrations were seen throughout the data collection period. During the data acquisition period, a diurnal variation in the NOx flux was observed, consisting of a downflux in the morning and an upflux in the afternoon. But unlike the NOx concentration, the magnitude and direction of the 5-day averages of the NOx varied with seasonal changes. The NOx flux in the winter (February) showed a net deposition at less than -1.0 ppb cm/s. Later in the year, the net flux changed to an upflux. In May, the upflux was at 6.0 ppb cm/s. The increase in the observed NOx upflux was apparently due to microbial activity in the soil or the maturing wheat plants, rather than to a seasonal warming that causes an increase in turbulent activity.

41206 **(PB—88-195193/XAB) Evaluation of composite receptor methods.** Dzubay, T.G. (Environmental Protection Agency, Research Triangle Park, NC (USA). Atmospheric Sciences Research Lab.). Apr 1988. 16p. (EPA—600/D-88/069). NTIS, PC A03/MF A01.

A composite-receptor model for PM-10 apportionment was evaluated to determine the stability of its solutions and to devise cost-effective measurement strategies. Ambient aerosol samples used in the evaluation were obtained with dichotomous samplers at three sites in the vicinity of Philadelphia, PA and were analyzed by x-ray fluorescence (XRF), instrumental neutron activation (INAA), scanning electron microscopy (SEM), and ion chromatography. The composite receptor model consisted of a wind trajectory method, chemical mass balances (CMB), and multiple linear regression (MLR). In resolving PM-10 into 11 components, SEM was essential for coal-fly ash and botanical matter, XRF was essential for an S-component and vehicle emissions, and INAA was essential for

fluidized catalytic crackers at refineries. The remaining components were determined well by either INAA or XRF. Ten to twenty samples were sufficient to determine average source contributions by CMB. Multiple linear regression required 30 or more samples to determine the S-component and at least 50 samples for vehicle emissions.

41207 **(PB—88-195227/XAB) Strategies for continuous monitoring of hydrogen chloride emissions from municipal solid-waste incinerators.** Jernigan, J.R.; Shanklin, S.; Rollins, R.; Logan, T.J.; Midgett, M.R. (Entropy Environmentalists, Inc., Research Triangle Park, NC (USA)). Apr 1988. 12p. NTIS, PC A03/MF A01.

The paper presents a discussion of sampling and analytical techniques for continuous monitoring of hydrogen chloride (HCl) emissions from incineration sources. The discussion focuses on commercially available systems for sample conditioning and measurement. Six HCl continuous-emission monitors were evaluated at a municipal facility for solid-waste incineration. Field-test results indicate that several techniques for continuous monitoring of HCl concentrations are available. Most of the analyzers tested, regardless of the detection or calibration techniques, indicated the same trend in the effluent HCl concentrations and produced data that was in good agreement with wet-chemistry results.

41208 **(PB—88-195235/XAB) Photochemical oxidant formation: overview of current knowledge and emerging issues.** Dimitriades, B. (Environmental Protection Agency, Research Triangle Park, NC (USA). Atmospheric Sciences Research Lab.). Apr 1988. 13p. (EPA—600/D-88/064). NTIS, PC A03/MF A01.

Despite 1-1/2 decades of control effort, the photochemical ozone problem continues to plague human society and ecology in the U.S. One reason alleged for the difficulty in achieving the established ozone air-quality standard is that current understanding of the science underlying the problem is still insufficient. Scrutiny of existing empirical and theoretical/experimental evidence revealed imperfections in ozone air-quality models and model application procedures. Latest chemical mechanism developments established the Carbon Bond Mechanism (CBM) and Carter-Atkinson-Lurmann-Lloyd (CALL) mechanisms as superior to others but still lacking in some respects. Precursor-related uncertainties are of consequence both for models requiring emission rate input and for models requiring ambient concentration input. Other factors affecting model predictions are the composition of VOC emissions and the amount and makeup of pollutants transported into the modeled atmosphere. Regional ozone air-quality models are now available and procedures are being developed for use of such models in formulating regional ozone control strategies. The relative roles of hydrocarbons (VOC) and nitrogen oxides (NOx) differ in the urban and the regional ozone formation phenomena.

41209 **(PB—88-195631/XAB) National ambient volatile organic compounds (VOCs) data base update, documentation. Final report.** Shah, J.J.; Heyerdahl, E.K. (Nero and Associates, Inc., Portland, OR (USA)). Mar 1988. 131p. NTIS, PC A07/MF A01.

For system on diskette, see PB—88-189022.

Data on the observed concentrations of three hundred twenty (320) volatile organic compounds (VOCs) were compiled, critically evaluated, and assembled into a relational data base. Ambient (i.e., outdoor) measurements, indoor data, and data collected with personal monitors are included. The data are primarily from the period 1970-1987 and for locations within the United States. In order to compare data from many different sources, each concentration record in the data base represents the daily average for a single chemical, wherever feasible. The total data base contains more than 175,000 concentration records. Summaries of the data distributions are tabulated in the report. Averages, medians and quartile values are given for each chemical measured in both the ambient and indoor site categories. Median values are also listed for each chemical for the eight specific site types included in the data report. The ambient site types are: remote, rural, suburban, urban, and source-dominated. The indoor category of site types include residential indoor, workplace (non-industrial), and personal monitors. The data have been assembled into a relational data base using dBASE III Plus, a commercially available data base management program. The report contains a complete description of the database files and a guide describing the use of a prepared program for searching and maintaining the data base.

41210 **(PB—88-195664/XAB) Findings of the chlorofluorocarbon chemical substitutes international committee. Final report.** Nelson, T.P. (Radian Corp., Austin, TX (USA)). Apr 1988. 142p. NTIS, PC A07/MF A01.

The report presents the findings of a select international committee of experts from industry and academia on the subject of chemical substitutes for fully halogenated chlorofluorocarbons (CFCs). The committee, over the course of two meetings, reviewed and discussed data and information on chemical alternatives for fully halogenated CFCs now in use. The committee acknowledged that, while there are many other possible chemical replacements, there is a dearth of information on these compounds with regard to property data, toxicity, and performance in end-use applications.

41211 **(PB—88-195706/XAB) Simulated effects of hydrocarbon emissions controls on seasonal ozone levels in the northeastern United States: a preliminary study.** Lamb, R.G. (Environmental Protection Agency, Research Triangle Park, NC (USA). Atmospheric Sciences Research Lab.). Apr 1988. 95p. (EPA—600/3-88/017). NTIS, PC A05/MF A01.

The second-generation Regional Oxidant Model (ROM2) was used to simulate ozone concentrations in the Northeastern United States over two-week periods in each of three months: April, July, and August 1980. In each period, three separate model simulations were performed. The first of these, the base case, used the 1980 NAPAP 5.3 emissions inventory to specify anthropogenic hydrocarbon and NOx emissions. The second simulation, Control Strategy 1, assumed county-specific reductions of 5% to 50% in hydrocarbon emissions and the third simulation, Control Strategy 2, reduced VOC emissions from Control Strategy 1 an additional 22% across the board. In all three simulations, the NOx emissions were the same and the hydrocarbon emissions from natural sources were identical. The predicted ozone changes that result from the emissions changes were extrapolated from the three, 2-week periods to the ozone season, which begins on 1 April and runs through 31 October. Three general conclusions were drawn: (1) reducing hydrocarbon emission rates generally reduces ozone levels; (2) the emissions changes proposed in control strategies 1 and 2 reduce peak O_3 concentrations most -- they have virtually no effect on concentrations below about the 95-percentile level; (3) the impact of controls on ozone levels is sensitive to meteorological conditions.

41212 **(PB—88-196167/XAB) Video-image analyses of the cross-stream distribution of smoke in the near wake of a building.** Huber, A.H.; Arya, S.P.S. (Environmental Protection Agency, Research Triangle Park, NC (USA). Atmospheric Sciences Research Lab.). Apr 1988. 8p. (EPA—600/D-88/066). NTIS, PC A02/MF A01.

In a wind-tunnel study, recorded video images of the top view of smoke dispersion in the wake of a building were analyzed. A continuous source of smoke was emitted at floor level, midway along the leeward side of the building. The technique and usefulness of analyzing video images of smoke is demonstrated in a study of building effects on smoke dispersion. The presentation discusses how the video-image intensity is corrected for background intensity and then normalized to a scale of 0 to 100%. Profiles of the normalized image mean intensity are compared with similar profiles for the mean concentration of hydrocarbon tracer. The distributions of intensity of cross-stream profiles are discussed. These distributions were analyzed in time and space. Also, time-averaged cross-stream profiles of mean, standard deviation, and other statistics of image intensity are compared with traditional concentration measurements for symmetric wake flow.

41213 **(PB—88-196175/XAB) Locating and estimating air emissions from sources of benzene. Final report, August 1986-March 1988.** Cruse, P.A. (Radian Corp., Research Triangle Park, NC (USA)). Mar 1988. 219p. (RAD—87-203-061-03-15). NTIS, PC A10/MF A01.

To assist groups interested in inventorying air emissions of various potentially toxic substances, EPA is preparing a series of documents such as this to compile available information on sources and emissions of these substances. The document deals specifically with benzene. Its intended audience includes Federal, State and local air-pollution personnel and others interested in locating potential emitters of benzene making gross estimates of air emissions therefrom. The document presents information on (1) the types of sources that may emit benzene, (2) process variations and release points that may be expected within these sources, and (3) available emissions information indicating the potential for benzene release into the air from each operation.

41214 **(PB—88-196225/XAB) Gap-filling PM10 emission factors for selected open-area dust sources.** Grelinger, M.A.; Muleski, G.; Kinsey, J.S.; Cowherd, C.; Hecht, D. (Midwest Research Inst., Kansas City, MO (USA)). Feb 1988. 55p. NTIS, PC A04/MF A01.

The report presents PM10 (particulate matter with an aerodynamic diameter of less than or equal to 10 micrometers) emission factors for open-area dust sources not currently addressed in AP-42. These emission factors were developed mainly through indirect estimation techniques, such as drawing upon existing emission factors from similar sources, or upon engineering judgment. These gap-filling factors provide a basis for completing PM10 emission inventories until more directly supportable factors can be developed.

41215 **(PB—88-196290/XAB) Screening methodology for assessing potential health effects from municipal sludge incinerators.** Fradkin, L.; Bruins, R.J.F.; Lutkenhoff, S.D.; Stara, J.F.; Lomnitz, E. (Environmental Protection Agency, Cincinnati, OH (USA). Office of Environmental Criteria and Assessment). 1987. 7p. (EPA—600/J-87/319). NTIS, PC A02/MF A01.

Pub. in Jnl. of the Air Pollution Control Association, Vol. 37, No. 4, 395-399(1987).

This paper describes a risk assessment methodology for preliminary assessment of municipal sludge incineration. The methodology is a valuable tool in that it can be used for determining the hazard indices of chemical contaminants that might be present in sewage sludge used in incineration. The paper examines source characteristics (i.e., facility design), atmospheric dispersion of emission, and resulting human exposure and risk from sludge incinerators. Seven of the ten organics were screened for further investigation. An example of the calculations are presented for cadmium.

41216 **(PB—88-196340/XAB) Chemistry and photochemistry of low-volatility organic chemicals on environmental surfaces.** Miller, G.C.; Hebert, V.R.; Zepp, R.G. (Nevada Univ., Reno (USA)). 1987. 6p. NTIS, PC A02/MF A01.

Pub. in Environmental Science and Technology, Vol. 21, No. 12, 1164-1167(Dec 1987).

Hydrophobic organic xenobiotics such as polychlorinated dibenzodioxins and polycyclic aromatic hydrocarbons have strong tendencies to sorb on environmental surfaces. This paper summarizes a workshop in which scientists and modelers assembled to discuss nonbiological processes that affect sorption to soil or sediment surfaces and on atmospheric particles. The 20 scientists discussed a variety of topics with a major emphasis on the fate of chlorinated dioxins. The topics include transformation processes, mobility of organic pollutants, fate of organics, and evaluative fate models.

41217 **(PB—88-196456/XAB) Health-hazard evaluation determination REPORT HE-76-97-430, FMC Corporation, Chain Division, Indianapolis, Indiana.** (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). Sep 1977. 36p. (NIOSH-TR-HHE—76-97-430). NTIS, PC A03/MF A01.

See also PB—82-199688.

Section 20(a)(6) of the Occupational Safety and Health Act of 1970, 29 U.S.C. 669(a)(6), authorizes the Secretary of Health, Education, and Welfare, following a written request by an employer or authorized representative of employees, to determine whether any substance normally found in the place of employment has potentially toxic effects in such concentrations as used or found. The National Institute for Occupational Safety and Health (NIOSH) received such a request from an authorized representative of Local 1150 of the United Steel Workers of America regarding the employees' alleged complaints of large amounts of powdered metal dust; molybdenum; powdered metal binder; continually filling air - frequent amount of smoke from adjoining heat treat, eye irritation, and irritations to breathing. The initial request also specified heat and noise as a problem area. Although the authors did provide some initial advice and consultation on heat and noise, there were no in-depth evaluations made on heat and noise as physical agents are not covered under Section 20(a)(6) of the basic act referenced in the previous paragraph. Therefore, heat and noise are not included as part of the report.

41218 **(PB—88-197470/XAB) National Air Toxics Information Clearinghouse: NATICH data base users guide for data viewing, February 1988.** Smith, S.A. (Radian Corp., Austin, TX (USA)). 27 Jan 1988. 111p. NTIS, PC A06/MF A01.

See also PB—86-123601, and PB—88-202734.

Contents include: the National Air Toxics Information Clearinghouse (the Clearinghouse, the NATICH data base, data collection, obtaining information from NATICH, using this guide); access to the NATICH data base (hardware and software requirements, authorization to logon, logon procedures, logoff procedures, if you have a problem); overview of the interactive data viewing system (contents of the data base, menu structure, report programs); selected report programs (agency reports, pollutant reports, source reports, bibliographic citations and ongoing research, risk analysis reports, permitting information reports).

41219 **(PB—88-197934/XAB) Development and field use of a snow collector for acid-precipitation studies.** Hall, D.J.; Cottrill, S.M.; Goldsmith, A.L.; Upton, S.L.; Waters, R.A. (Warren Spring Lab., Stevenage (UK)). Jan 1988. 69p. (LR—585(PA)M). NTIS, PC E06/MF E06.

This report describes the development of a novel form of snow collector, based on sound aerodynamic principles, which will maintain a high collection efficiency in strong winds. The collector was intended for use in acid-precipitation studies, where there are particular difficulties in obtaining complete, uncontaminated samples of snow precipitation suitable for analysis. A suitable design of the collector for field use was produced and nine collectors manufactured and used at six sites, mainly in Scotland, during the winter of 1985/6. The design proved to be an effective collector and generally worked well, the only significant fault being the loss by evaporation of a proportion of small precipitation samples.

41220 **(PB—88-198452/XAB) Comparison of fibre-counting stopping rules in the application of the membrane-filter method. Phase 2. Technical memo. (Final).** Crawford, N.P.; MacLaren, W.M.; Brown, P.; Jones, A.D. (Institute of Occupational Medicine, Edinburgh (UK)). Dec 1987. 62p. (TM—87/19). NTIS, PC E06/MF E06.

In the European Reference Method (ERM) for determining airborne asbestos-fibre concentrations in the workplace, fibre counting stops once 100 fibers have been counted or 100 fields of view have been examined, whichever is reached first, with a minimum of 20 fields being evaluated. This ERM stopping rule directs more counting effort than is necessary towards concentrations well below present control limits for asbestos fibres. A preliminary investigation confirmed that alternative stopping rules could be devised to give comparable results to the ERM rule, while yielding substantial savings in evaluation time for low-density slides. Their applicability, however, was limited to a single control limit value and specific sampling conditions. This report describes an extension to the study to identify and validate a more-robust candidate stopping rule of generally wider applicability.

41221 **(PB—88-198460/XAB) Historical environmental investigation at 13 European man-made mineral-fibre production plants (revised). Technical memo.** Cherrie, J.; Dodgson, J. (Institute of Occupational Medicine, Edinburgh (UK)). Oct 1987. 125p. (TM—85/8). NTIS, PC E07/MF E07.

See also PB—86-179363.

The report describes a historical environmental investigation undertaken at thirteen European man-made mineral fibre (MMMF) production plants on behalf of the industries' Joint European Medical Research Board. The work was completed in conjunction with the International Agency for Research on Cancer who have been responsible for co-ordinating an epidemiological investigation of the health of workers at the same plants. The aims of the historical environmental study were twofold: firstly, to make an assessment of occupational exposures to environmental agents which may be related to the incidence of lung cancer; and, secondly, to provide estimates of historical MMMF concentrations in the factories. The report summarizes information, from the first phase of the work, obtained using a self-administered questionnaire distributed to each factory management.

41222 **(PB—88-198577/XAB) Development of the fuel-choice module in the Industrial Combustion Emissions Model. Volume 1. Phases 1 and 3. Final report, October 1985-March 1986.** Hogan, T. (Energy and Environmental Analysis, Inc., Arlington, VA (USA)). Apr 1988. 93p. NTIS, PC A05/MF A01.

See also Volume 2, PB—88-198585.

The report describes the development of and basis for the improved fuel-choice decision logic used in Version 6.0 of the Industrial Combustion Emissions (ICE) Model, one of four stationary-source emission and control-cost forecasting models developed by the EPA for the National Acid Precipitation Assessment Program (NAPAP). The ICE Model projects air-pollution emissions (sulfur dioxide, sulfates, nitrogen oxides, and particulate matter), costs, and fuel mix for industrial fossil-fuel-fired (natural gas, distillate and residual fuel oil, and coal) boilers by state and year (1980 baseline, 1985, 1990, 1995, 2000, 2010, 2020, and 2030). The ICE Model was originally developed from the Industrial Fuel Choice Analysis Model (IFCAM), which relies on a life-cycle cost-of-fuel logic. The report describes the development of an updated forecast model (i.e., ICE) which relies on a broader range of factors shown to be relevant to the industrial-boiler fuel-choice decision.

41223 **(PB—88-198585/XAB) Development of the fuel-choice module in the Industrial Combustion Emissions Model. Volume 2. Phase 2.** Horowitz, J.L.; Cook, T. (Iowa Univ., Iowa City (USA)). Apr 1988. 60p. NTIS, PC A04/MF A01.

See also Volume 1, PB—88-198577.

This report describes the development of a model for predicting industrial firms' choices of boiler fuel for production of process steam. In contrast to fuel-choice models currently in operation, the model described here predicts fuel choices probabilistically, rather than deterministically. In addition, the model is empirical, does not assume that the costs relevant to fuel choices necessarily are best summarized by a single, total annualized cost, and provides a way to represent the effects of non-cost factors that may influence industrial-boiler fuel-choice decisions. These characteristics enable the model to provide a considerably more accurate description of fuel choices than do deterministic models that assume these choices to be based only on considerations of total annualized costs. The work was instrumental in developing a clearer understanding of the relative importance of the factors at work that have major influence on the industrial-boiler fuel-choice decision.

41224 **(PB—88-198619/XAB) Hazardous-waste treatment, storage, and disposal facilities (TSDF) air-emission models. Documentation.** (Environmental Protection Agency, Research Triangle Park, NC (USA). Office of Air Quality Planning and Standards). Dec 1987. 355p. (EPA—450/3-87/026). NTIS, PC A16/MF A01.

For system on diskette, see PB—88-198601.

Analytical models are presented for estimating air emissions from hazardous-waste treatment, storage, and disposal facilities (TSDF). Air-emission models were developed for aerated and non-aerated surface impoundments, land-treatment facilities, landfills, and wastepiles. Emission model predictions are compared to available field data. The report also includes emission factors for transfer, storage, and handling operations at TSDF. The models have been assembled into a spreadsheet that is included in the report as floppy diskette for use on a microcomputer. Appendices include a list of physical-chemical properties for approximately 700 compounds and a comprehensive source list of pertinent literature in addition to that cited in the report.

41225 **(PB—88-198809/XAB) Survey of gaseous air pollutants at selected UK sites: XVIII. Data digest for Sibton, Suffolk, 1984.** Broughton, G.F.J.; Bower, J.; Drury, V.; Lilley, K.; Powell, K. (Warren Spring Lab., Stevenage (UK)). 1987. 28p. (LR—603(AP)M). NTIS, PC E05/MF E05.

See also PB—84-204866.

Ambient air-quality measurements of ozone continued during 1984 at Sibton, Suffolk sponsored by the Department of the Environment. Insolation was also recorded. These data are presented in the form of frequency distributions, averages, and other parameters for winter, summer, annual, and monthly periods. Time-series graphs of ozone concentrations for 1984 and of the historical data base between July 1973 and December 1984 are also included.

41226 **(PB—88-199443/XAB) Using SAS (trade name) color graphics for video image analysis.** Borek, J.; Huber, A. (Computer Sciences Corp., Research Triangle Park, NC (USA)). Apr 1988. 7p. NTIS, PC A02/MF A01.

Wind-tunnel studies are conducted to evaluate the temporal and spatial distributions of pollutants in the wake of a model building. As part of these studies, video pictures of smoke are being used to study the dispersion patterns of pollution in the wake of buildings. The video-image format has potential as a quantifiable electronic medium. Analysis of series of selected pixels (picture elements) for video images is used to evaluate temporal and spatial scales of smoke puffs in the wake of the building.

41227 **(PB—88-200860/XAB) Role of rogue droplet combustion in hazardous-waste incineration. Final report, January 1984-May 1987.** Srivastava, R.K.; Ryan, J.V.; Roy, J.V. (Acurex Corp., Research Triangle Park, NC (USA)). Apr 1988. 286p. NTIS, PC A13/MF A01.

This report gives results of a study to develop a predictive understanding of individual droplet trajectories in turbulent-diffusion flames. In the incineration of liquid hazardous wastes, atomization quality may limit destruction efficiency. Large, nonmean droplets in a fuel spray can pass through the flame zone prior to complete evaporation, and may subsequently fail to burn completely due to insufficient temperature and/or flame radicals. Data from 10 trajectories were correlated using asymptotic forms for drag coefficient. A trajectory model containing the local drag coefficient was fit to the experimental data by a nonlinear regression. The resulting model was then able to predict 4 additional measured trajectories and 39 additional measured trajectory endpoints with acceptable accuracy. Thus, the influence of droplet spacing on the local drag coefficient of a single droplet was quantified. Predictions of model penetration are very close to experimental findings, except for changing initial spacing of droplets.

41228 **(PB—88-201157/XAB) Wood smoke: measurement of the mutagenic activities of its gas- and particulate-phase photooxidation products.** Kleindienst, T.E.; Shepson, P.B.; Edney, E.O.; Claxton, L.D.; Cupitt, L.T. (Northrop Services, Inc./Environmental Sciences, Research Triangle Park, NC (USA)). 1986. 11p. NTIS, PC A03/MF A01.

Pub. in Environmental Science Technology, Vol. 20, No. 5, 493-501(May 1986).

Dilute mixtures of wood-combustion emissions (with and without additional NOx) were irradiated in a 22.7-m3 Teflon smog chamber. The effluent was tested for mutagenic activity by exposing Salmonella typhimurium, strains TA100 and TA98, to the filtered gas-phase components. The particulate matter was tested by using the plate incorporation procedure. Without added NOx, irradiated dilute wood smoke showed a measurable increase in mutagenic activity for gas-phase products only. Additional NOx was added in other irradiations to enhance the formation of gas- and particulate-phase products.

41229 **(PB—88-201504/XAB) Stability of parts-per-billion hazardous organic cylinder gases and performance audit results of source test and ambient-air-measurement systems. Status report 4.** Jayanty, R.K.M.; Sokol, C.K.; Decker, C.E. (Research Triangle Inst., Research Triangle Park, NC (USA). Center for Environmental Measurement). Jan 1988. 289p. NTIS, PC A13/MF A01.

See also PB—87-168803.

An evaluation of 29 gaseous organic compounds at PPB levels in compressed gas cylinders was conducted by the U.S. Environmental Protection Agency (EPA). Primary objectives of this on-going project are to: (1) evaluate the quality of measurements made by EPA, state/local agencies, or their contractors by using ppb gas cylinders for performance audits to assess relative accuracy of source measurement systems during hazardous-waste trial-burn tests and ambient air-monitoring programs; (2) verify the manufacturer's certified analysis of the multi-component gas mixtures; (3) determine stability of gas mixtures with time; and (4) develop new audit materials as requested by EPA. Cylinders consist of 5 mixtures of 5, 6, 7, 9, and 18 organic compounds each. These mixtures were blended by a commercial gas supplier in aluminum cylinders in a balance gas of nitrogen. To date, 198 performance audits have been initiated and 172 completed. Results of these audits and description of experimental procedures used for analyses and available stability data are in Status Report No. 4.

41230 **(PB—88-202122/XAB) Rate constants for some oxidations of S(IV) by radicals in aqueous solutions.** Huie, R.E.; Neta, P. (National Bureau of Standards, Washington, DC (USA). Chemical Kinetics Div.). 1987. 7p. NTIS, PC A02/MF A01.

Pub. in Atmospheric Environment, Vol. 21, No. 8, 1743-1747(1987).

Rate constants were measured for several radical reactions important in the autoxidation of sulfite(IV) in atmospheric droplets. In some cases, the rate constants are significantly different than those used previously in atmospheric models. The results suggest that secondary radical-radical reactions may be of considerable importance in the mechanism of sulfite autoxidation in the atmosphere.

41231 **(PB—88-202130/XAB) Application of game theory in the design of optimal air-pollution-control measures.** Hati, S.K.; Lamb, R.G. (Environmental Protection Agency, Research Triangle Park, NC (USA). Atmospheric Sciences Research Lab.). 1987. 12p. (EPA—600/J-87/325). NTIS, PC A03/MF A01.

Pub. in Atmospheric Environment, Vol. 21, No. 8, 1833-1841(1987).

Methods of game theory are used to develop a technique for finding optimal solutions to air-quality problems that involve multiple objectives. The technique is demonstrated using a hypothetical problem in which sites for two new power plants are sought that optimally satisfy five objectives subject to given constraints. The five objectives are minimization of (1) fuel and pollutant control costs, (2) long-term averaged SO_2 concentration, (3) peak short-term SO_2 concentration, (4) long-term averaged particulate concentration, and (5) peak short-term particulate concentration. The constraints include the number and locations of fuel sources, the energy and pollutant contents and cost of fuel from each source, the admissible areas for plant locations, etc. The focus of the paper is on concepts and technique development rather than the solution of specific problems.

41232 **(PB—88-202148/XAB) Representation of atmospheric motion in models of regional-scale air pollution.** Lamb, R.G.; Hati, S.K. (Environmental Protection Agency, Research Triangle Park, NC (USA). Atmospheric Sciences Research Lab.). 1987. 12p. (EPA—600/J-87/326). NTIS, PC A03/MF A01.

Pub. in Jnl. of Climate and Applied Meteorology, Vol. 26, No. 7, 837-846(Jul 1987).

A method is developed for generating ensembles of wind fields for use in regional-scale (1000-km) models of transport and diffusion. The underlying objective is a methodology for representing atmospheric motion in applied air-pollution models that permits explicit treatment of the uncertainty inherent in the specification of atmospheric states. The nature of this uncertainty is illustrated by showing that a set of discrete meteorological observations made at a given moment in time and the diagnostic equations of fluid motion together define a manifold in function space each point of which is a possible description of the state of the atmosphere at the moment the observations were made. It is argued that hypotheses can be adduced regarding the liklihood that individual points on the manifold describe the atmospheric state at the time of the observations; but that, contrary to common practice, adequate information does not exist to allow one to state with certainty that a specific function is the correct description. The paper shows that dynamic programming is ideally suited to finding these sequences which constitute the desired ensemble of wind specifications in space and time.

41233 **(PB—88-202171/XAB) Inter-storm comparisons from the OSCAR (Oxidation and Scavenging Characteristics of April Rains) high-density network experiment.** Chapman, E.G.; Luecken, D.J.; Dana, M.T.; Easter, R.C.; Hales, J.M. (Pacific Northwest Lab., Richland, WA (USA)). 1987. 21p. NTIS, PC A03/MF A01.

Pub. in Atmospheric Environment, Vol. 21, No. 3, 531-549(1987).

The high-density network component of the Oxidation and Scavenging Characteristics of April Rains (OSCAR) experiment combined aircraft, surface, and sequential precipitation chemistry measurements to characterize the physicochemical and dynamic features of four storms sampled during an April 1981 field investigation. A surface network of 47 precipitation-sampling stations, covering a roughly square region 110 km on a side, was established in the area surrounding Fort Wayne, Indiana. The network provided temporal and spatial resolution of rainfall chemistry via the use of specially designed automatic sequential bulk-precipitation collectors, while aircraft and surface sampling provided measurements of the major aerosols and trace gases in the boundary-layer inflow region. Composite concentration and ion-ratio profiles for the events were analyzed to investigate potential pollutant-scavenging pathways.

41234 **(PB—88-202726/XAB) Inhalation uptake of xenobiotic vapors by people. Final report, August 1986-March 1988.** Raabe, O.G. (California Univ., Davis (USA)). Mar 1988. 94p. NTIS, PC A05/MF A01.

The objective of the study was to provide information on the degree to which the body absorbs inhaled toxic substances from air containing ambient concentrations. Four human subjects, two men and two women, inhaled each test compound (^{14}C) labeled benzene, chloroform, methyl bromide, trichlorethylene, and formaldehyde twice, once through the nose and once through the mouth. In addition, each subject inhaled benzene through the mouth while engaged in exercise. The uptake (% of inhaled) of each of the compounds was as follows: chloroform 45.6% nasal, 49.6% oral; trichloroethylene 53.9% nasal, 55.3% oral; methylbromide 55.4% nasal, 52.1% oral; benzene 60.0% nasal, 54.6% oral; formaldehyde 75.1% nasal, 86.4% oral. The uptake of benzene during exercise was 41.6%.

41235 **(PB—88-202734/XAB) National Air Toxics Information Clearinghouse: NATICH data base users guide for data entry and editing, February 1988. Interim report.** Smith, S.A. (Radian Corp., Austin, TX (USA)). 3 Feb 1988. 96p. NTIS, PC A05/MF A01.

See also PB—87-175576, and PB—88-197470.

This report serves as a guide for State and local agency personnel entering data into the National Air Toxics Information Clearinghouse (NATICH) data base. The NATICH data base is a computerized data base which contains indexed information on toxic and potentially toxic air pollutants. The data base was established by EPA to support State and local programs in the control of non-criteria air pollutants.

41236 **(PB—88-202932/XAB) Multi-element and Sulfate-in-Particulate Surveys: summary of the seventh year's results (1982/83).** Carroll, J.D. (Warren Spring Lab., Stevenage (UK)). 1987. 55p. (LR—622(AP)M). NTIS, PC E06/MF E06.

See also report dated 1984, PB—85-181725.

Warren Spring Laboratory undertakes the Multi-Element and Sulfate-in-Particulate Surveys for the Department of the Environment. For the Multi-Element Survey a selection of trace elements is monitored on a monthly basis at urban sites in the UK: originally numbering 20, the network of sites was reduced to five in April 1978. Particulate sulfate, black smoke and sulfur dioxide are monitored on a daily basis for the Sulfate-in-Particulate Survey. Initially there were 20 sites, gradually reducing in number to one in April 1980. The report presents a summary of the results for the seventh year (1982/83) of both surveys and a brief analysis of the results obtained over the seven-year period.

41237 **(PB—88-203823/XAB) Assessment of the UK position with respect to the 1987 WHO (World Health Organization) air-quality guidelines.** Williams, M.L. (Warren Spring Lab., Stevenage (UK)). Jan 1988. 24p. (LR—650(AP)M). NTIS, PC E04/MF E04.

In December 1987 the World Health Organization published a document containing air-quality guidelines for twenty substances. The report briefly summarizes available UK data in comparison with these guidelines.

41238 **(PB—88-204235/XAB) Sampling/analytical method evaluation for ethylene oxide emission and control-unit efficiency determinations.** Steger, J.; Gergen, W.; Margeson, J.H. (Radian Corp., Research Triangle Park, NC (USA)). May 1988. 113p. NTIS, PC A06/MF A01.

Radian Corporation, assisting the Environmental Monitoring Systems Laboratory, Environmental Protection Agency, Research Triangle Park, North Carolina, performed a field evaluation of a method for sampling and analyzing ethylene oxide (EO) in the vent stream from a sterilization chamber and a dilute-acid scrubber. The utility of the sampling method for measuring the efficiency of the control unit was also evaluated. The evaluated sampling and analysis procedure used semi-continuous direct sampling with on-line gas chromatographic analysis. Laboratory studies of the sampling method previous to the field test showed that semi-continuous direct sampling was capable of measuring EO emissions to within 11% of the expected value with a between-trial precision of 5%.

41239 **(PB—88-204649/XAB) Caution: asbestos dust is hazardous to your health.** (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). 1987. 17p. NTIS, PC A03/MF A01.

This pamphlet is designed to bring current awareness of the asbestos hazard to the general public. Asbestos is defined as a mineral and the properties of its various types are depicted. Uses for asbestos are listed for the construction industry, automotive industry, textile industry, and other fields where the substance has been used to strengthen metals exposed to heat. The danger from asbestos stems from inhaling the fibrous dust particles. The danger varies according to the intensity of the dust inhaled, the susceptibility of the exposed individual, the size and variety of the fibers, and the presence of other pollutants inhaled as well. The latency period before symptoms appear is discussed and the diseases of asbestosis, mesothelioma, cancer of the respiratory system, and asbestos corns are described. Groups of workers who may be exposed are listed. While there is no known treatment for asbestos-related diseases, regular checkups are urged and the need for controlling on-the-job exposure is stressed. Safety standards are listed and safety practices including labeling of hazardous materials, use of personal safety equipment, on the job housekeeping, medical surveillance, and education of employers and employees are discussed.

41240 **(PB—88-204722/XAB) NIOSH (National Institute for Occupational Safety and Health) manual of analytical methods (Third Edition). Second supplement.** (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). 15 Aug 1987. 286p. (DHEW/PUB/NIOSH—87-117). NTIS, PC A13/MF A01.

See also PB—83-105445.

This supplement contains air and biological analytical methods which have been evaluated by NIOSH for use in determining concentrations of the following substances: acetaldehyde, alkaline dusts, aminoethanol compounds, arsenic, asbestos fibers, soluble barium, benzene, beryllium, biphenyl, bromotrifluoromethane, 1,3-butadiene, cadmium, chlorinated diphenyl ether, chloroacetic acid, diborane, dichlorodifluoromethane, 1,2-dichlorotetrafluoroethane, ethylene dibromide, ethylene oxide, fibers, furfural, halogenated hydrocarbons, iodine, methyl chloride, methyl ethyl ketone peroxide, methylene chloride, mineral oil mist, naphthylamines, nickel carbonyl, nitroethane, nitromethane, 2-nitropropane, organotin compounds, phosphorus, polychlorobenzenes, polychlorobiphenyls, pyridine, stibine, sulfur dioxide, tetrachlorodifluoroethanes, 1,1,2,2-tetrachloroethaylene, tetraethyl lead, toluene, toluene-2,4-diisocyanate, trichloroethylene, trichlorofluoromethane, 1,1,2-trichloro-1,2,2-trifluoroethane, vanadium oxide, and vinylidene chloride.

41241 **(PB—88-205414/XAB) Urban ozone and the Clean Air Act: problems and proposals for change. Staff Paper.** (Office of Technology Assessment (U.S. Congress), Washington, DC). Apr 1988. 164p. NTIS, PC A08/MF A01.

Contents include: effects of ozone (effects on human health, exposure to ozone, effects of ozone on crops and forests); controlling emissions (relationship of emissions to ozone concentrations, volatile organic compounds: characterization of current and future emissions, potential emissions reductions from control strategies analyzed by OTA, comparison of potential emissions reductions and reductions needed to attain the ozone standard, cost of control); ozone and the Clean Air Act (evolution of ozone control under the Clean Air Act, state implementation plan (SIP) development and implementation, failure to meet the ozone standard following the 1977 amendments); proposals for change: S.1894, H.R.3054, and EPA's proposal (overall requirements, control requirements).

41242 **(PB—88-205455/XAB) Summary of emissions associated with sources of naphthalene.** (Environmental Protection Agency, Research Triangle Park, NC (USA). Office of Air Quality Planning and Standards). 30 Oct 1986. 117p. (EPA—450/3-88/003). NTIS, PC A06/MF A01.

The purpose of this document is to identify and quantify, on a preliminary basis, all emission sources of naphthalene. These estimates will be used to estimate public exposure to naphthalene using EPA's human exposure model (HEM). Information used to assemble this document came from existing information sources.

41243 **(PB—88-205703/XAB) Selective reduction of NO with NH_3 over various supported vanadia catalysts.** Janssen, F.J.J.G. (Keuring van Electrotechnische Materialen N.V., Arnhem (Netherlands)). 1988. 60p. NTIS, PC E04/MF A01.

Pub. in Kema Scientific and Technical Reports, Vol. 6, No. 1, 1-55(1988).

The work described in this paper concentrates on: (1) the mechanism of the reaction of NO, NH_3 and O_2 over the monolayer catalyst V_2O_5 on TiO_2, and (2) the development of silica-supported vanadia/titania catalysts for the selective reduction of NOx by ammonia in the presence of an excess of oxygen. The mechanistic work was carried out with the aid of labelled molecules such as $^{15}NH_3$, ^{15}NO and $^{18}O_2$. The role of O_2 and NH_3 is discussed in both a qualitative and a quantitative sense. The results confirm that lattice oxygen participates in the reaction. Water, produced from the reaction involving NO, NH_3 and O_2, is formed at two sites; the first part comes from the reaction of gaseous nitric oxide and adsorbed ammonia via an Eley-Rideal mechanism; the other part comes from a surface dehydration process. Evidence is given that ammonia does not react with oxygen during the reaction, but that nitrogen and nitrous oxide were produced by a reaction involving all three species: NO, NH_3 and O_2. Nitrous oxide and water are both formed at different sites of the catalyst.

41244 **(PB—88-206768/XAB) Indoor-air-quality research.** (Gas Research Inst., Chicago, IL (USA)). 1988. 9p. (GRI—88/0122). NTIS, PC A02/MF A01.

Color illustrations reproduced in black and white.

This brochure provides a description of GRI's research program on indoor air quality. The program emphasizes risk-assessment studies that describe the nature and extent of risks to populations exposed to emissions from gas appliances. Studies sponsored are in the areas of health effects assessment, emission sources characterization, and exposure level assessment. Risk management research is oriented towards the exploration of cost-effective alternatives to reduce population exposure to pollutants. Studies sponsored are directly related to the reduction of nitrogen dioxide levels in houses using gas appliances. Work includes the development of modifications to existing systems as well as new technologies.

41245 (PB—88-209200/XAB) Shearer-mounted dust collection: evaluation of ventilated cutting drums. Open File Report (Final). Kelly, J.S.; Muldoon, T.L. (Foster-Miller, Inc., Waltham, MA (USA)). Jun 1987. 53p. NTIS, PC A04/MF A01.

See also PB—84-126614.

Effective control of respirable dust is one of the most serious problems associated with longwall mining in the United States. This report describes the development and the underground evaluation of ventilated cutting drums, on a double ended ranging-drum shearer. The ventilated drum uses high pressure (1500 psi) water sprays to draw air (3500 cfm) through 12 airmoving tubes mounted in the drum hub. The sprays draw dusty air from the face side of the drum, scrub the air, and discharge the clean air on the gob side of the drum against a deflector plate. During a three-week underground evaluation, the cutting drums reduced shearer-generated dust levels at the shearer operators position by 40%, at the shield operators downwind of the shearer by 55%, and at the tailgate by 55%. Cutting and loading performance of the drums were superior to the mine's conventional drums. After the evaluation, the mine continued to use the ventilated drums to finish mining the panel.

41246 (PB—88-214002/XAB) 1985-86 measurements with the tunable-diode-laser absorption spectrometer. Final report. Mackay, G.I.; Schiff, H.I. (Unisearch Associates, Inc., Concord, Ontario (Canada)). 12 Apr 1988. 195p. NTIS, PC A09/MF A01.

See also PB—88-133269.

A Tunable Diode Laser Absorption Spectrometer (TDLAS) system has been developed under contract with CRC for measurement of trace substances in the atmosphere. Under a subsequent contract, the repertoire of atmospheric gases that can be measured by this technique was extended to include NH_3, H_2O_2, SO_2 and HCHO. The system was modified to permit the near simultaneous measurements of two species. This was accomplished by incorporating two separate cold heads, each containing a set of 4 diode lasers. The Unisearch and AES TAMS-2B instruments participated in an HNO_3 intercomparison study at Claremont CA in September 1985. The TDLAS data agreed within combined uncertainties with the FTIR and denuder difference methods but were lower than filter pack measurements and higher than the annular denuder measurements. The agreement between measurements made by TDLAS, the fluorometric methods and bubbler techniques for H_2O_2 was not as good. The results of these measurements are being prepared for publication.

41247 (UCRL—98125) Development and use of a branch exposure chamber to determine the effects of ozone on Pinus ponderosa: Objectives and experimental design. Houpis, J.L.J.; Surano, K.A.; Cowles, S. (Lawrence Livermore National Lab., CA (USA)). Jan 1988. Contract W-7405-ENG-48. 6p. (CONF-880267—1). NTIS, PC A02/MF A01;1; GPO Dep. Order Number DE88008912/JAW.

From U.S. Forest Service/EPA Forest Response Program annual meeting; Corpus Christi, TX, USA (23 Feb 1988).

This research will develop a branch exposure chamber (BEC) to determine if the amount of carbon a branch receives from neighboring branches is altered by the presence of a BEC, or is altered by the imposition or exclusion of O_3, and to examine if the response of mature branches is different.

41248 (VTT-TIED—817) Emission measurements of energy production. Sampling systems and analysis of PAH-, PCDD- and PCDF-compounds. Mroueh, U.-M.; Tirkkonen, T.; Laukkarinen, A.; Hoffren, H. (Valtion Teknillinen Tutkimuskeskus, Espoo (Finland)). Jan 1988. 60p. (In Finnish). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88753766/JAW.

In this literature review different methods used for sampling and analysing polycyclic organic hydrocarbons (POH), polychlorinated dibenzo-p-dioxin (PCDD) and dibenzofurans (PCDF) are presented. The problems in sampling and analysing these compounds from flue gases are discussed.

41249 Water interference of pulsed fluorescence SO_2 monitor. Stelson, A.W.; Bao, X. (Atlanta Univ. Center, Inc., GA (USA)). *Journal of the Air Pollution Control Association;* **38**: No. 4, 420(Apr 1988). Contract FG22-85PC80539.

Our laboratory has been using a Thermo Electron Model 40 Pulsed Fluorescence SO_2 Monitor, Serial Number 40-19670-185, without sample conditioner to measure sulfur dioxide in synthetic flue gases. The flue gases are generated by mixing pure (greater than 99.98 percent purity) sulfur dioxide, air, nitrogen and carbon dioxide with a rotameter gas dilution system. By knowing the flow rates of the gases, the concentration of sulfur dioxide in the flue gas can be calculated. By performing an error analysis, this system should be able to generate a sulfur dioxide concentration within 2 percent. A typical calibration curve for this instrument shows a maximum difference between the calculated concentration and the measured concentration of approximately 5.0 percent. With the addition of water, the signal corresponding to sulfur dioxide changed significantly. The sulfur dioxide concentration was approximately 1200 ppm. Figure 1 shows an average error approximately 35 percent occurs for water concentrations greater than 2 mole percent. This results indicates extreme care should be used when using pulsed fluorescence without a conditioner to measure sulfur dioxide in the presence of water. The exact mechanism of this interference is undetermined at this time.

41250 Detection and quantification of hydroxylated nitro polynuclear aromatic hydrocarbons and ketones and hydroxylated nitro aromatic compounds in an ambient air particulate extract. Nishioka, M.G.; Contos, D.A.; Ball, L.M.; Lewtas, J. (Battelle Columbus Div. (US)). pp 665-666 of Measurement of toxic and related air pollutants: Proceedings of the 1987 EPA/APCA symposium. Pittsburgh, PA; Air Pollution Control Assoc. (1987). (CONF-8705149—).

From EPA/APCA symposium on measurement of toxic and related air pollutants; Research Triangle Park, NC, USA (3 May 1987).

Highest percentages of mutagenic activity for urban air particulate extracts are associated with the polar compound class fractions. Many of the components of these fractions have not been identified, and the mutagenic species, in particular, have not been detected. The identification of hydroxylated nitro polynuclear aromatic hydrocarbons (OH-NO_2-PAH), hydroxylated nitro polynuclear aromatic ketones (OH-NO_2-PAK) and hydroxylated nitro aromatic (OH-NO_2-Ar) compounds is presented here. Bioasssay-directed fractionation through four sequential separations led to detection of OH-NO_2-PAHPAK in a mutagenic and substantially simplified subfraction of an urban air particulate (<1.7 μm diameter) extract. Identifications have been made from both electron impact (EI) and highly compound selective negative chemical ionization (NCI) HRGCMS analyses. Quantification of these compounds has been achieved using NCI HRGCMS. The presence of OH-NO_2-PAH in particular matter has been suggested to account for mutagenicity in polar extract fractions. Mechanisms have been proposed by which atmospheric hydroxylation of PAH followed by nitration should yield both NO_2-PAH and OH-NO_2-PAH. Similar mechanisms have been used to explain the formation of OH-NO_2-Ar in smog chamber studies of toluene. The importance of OH-NO_2-PAH became apparent when OH-NO_2-pyrenes were first identified as mutagenic mammalian metabolities of 1-NO_2-pyrene. The importance of OH-NO_2-Ar became apparent when NO_2-phenols were identified as phytotoxic agents present in rain. In addition, at least one NO_2-cresol has been identified as a mammalian metabolite of a NO_2-toluene isomer. Increasing evidence suggests that OH-NO_2-PAH are

not only important products of metabolism of NO_3-PAH in vivo but may also be important genotoxins to which humans may be exposed via urban air particulate matter.

41251 Organic vapor phase composition of sidestream and environmental tobacco smoke from cigarettes. Higgins, C.E.; Jenkins, R.A.; Guerin, M.R. (Organic Chemistry Section, Analytical Chemistry Div., Oak Ridge National Lab., Oak Ridge, TN (US)). pp 140-151 of Measurement of toxic and related air pollutants: Proceedings of the 1987 EPA/APCA symposium. Pittsburgh, PA; Air Pollution Control Assoc. (1987). (CONF-8705149—). Contract AC05-84OR21400.

From EPA/APCA symposium on measurement of toxic and related air pollutants; Research Triangle Park, NC, USA (3 May 1987).

Environmental tobacco smoke (ETS) has received considerable attention because of its contribution to indoor air pollution. While some studies have attempted to estimate the exposure of humans to ETS constituents by extrapolating from information gleaned from investigations of sidestream smoke (SS), few studies have reported a direct comparison between the composition of SS and that of ETS. In the study reported here, the authors describe the relative compositional similarities and differences between the vapor phase of SS and that of ETS. SS was generated under different conditions. Both a new laminar flow chamber, which prevents significant alteration of the near-cigarette environment, and a modified Neurath chamber were used for SS generation. ETS samples were collected from an office environment. Vapor phase samples were collected on multi-media resin sorbent traps and analyzed using thermal desorption gas/liquid chromatography employing flame ionization, nitrogen-specific, and mass selective detection. Influences on the compositional profiles by the manner in which the SS is generated are described, as well as the differences between SS and ETS composition resulting from phase transition.

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REFER ALSO TO CITATION(S) 39273, 39359, 39416, 39419, 39777, 39833, 39859, 40148, 40162, 41140, 41162, 41321, 41322, 41568

41252 (AERE-R—12872) Radioactive fallout in air and rain. Results for 1985 and 1986. Cambray, R.S.; Playford, K.; Lewis, G.N.J.; Burton, P.J. (UKAEA Harwell Lab. Environmental and Medical Science Div.). Oct 1987. 26p. (DOE-RW—87.22). H.M. Stationery Office, London, price Pound 4.00.

Samples of atmospheric particulate and rainwater have been collected from the United Kingdom and elsewhere. Results are presented of analyses of these samples for various fission products and certain other radionuclides. The average concentrations of long-lived fission products in air and rain in the United Kingdom in 1985 were near to or below the limit of detection and lower than at any time since measurements began in 1953. The Chernobyl accident of 26 April 1986 produced a sharp increase in the concentrations of caesium-137 in air and rain in the northern hemisphere. Levels of Cs-137 in some parts of the United Kingdom were greater than any previously recorded. Plutonium concentrations in air and rainwater were a very small fraction of the NRPB's Generalised Derived Limit for members of the public. There was negligible contribution from the Chernobyl accident. Strontium-90 deposited in the United Kingdom in 1985 was below the limit of detection. The deposits in 1986 were generally about 2% of that from Cs-137. The estimated cumulative worldwide deposit of Cs-137 at the end of 1986 is about 10% greater than at the end of 1985. This increase is attributable to the Chernobyl accident. The gamma and beta-ray dose rates from fallout at Chilton are estimated from the observed deposition.

41253 (CEA-DAS—328) Comparative evaluation between radioactive fallout of Chernobylsk-4 reactor and atmospheric nuclear explosion. Doury, A. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. d'Analyse de Surete). Nov 1986. 36p. (In French). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88752404/JAW.

In this paper the author comparates the atmospheric diffusion coefficients and the radioactive fallouts for Chernobylsk-4 reactor and atmospheric nuclear explosions.

41254 (CNEN-DR-GPR-DAS—01/87) Determination of atmospheric dispersion factors in emergency situations in Almirante Alvaro Alberto nuclear power plant - unit 1. Leao, I.L.B. (Comissao Nacional de Energia Nuclear de Brasil, Rio de Janeiro. Dept. de Reatores). Aug 1987. 24p. (In Portuguese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88701546/JAW.

The necessity of Knowing the atmospheric dispersion factor, used to obtain the first estimation dose in the public case for accidents with releasing of radioactive material to atmosphere in Almirante Alvaro Alberto nuclear power plant - unit I, lead to the development of a fast and efficient method to determine the dilution factors, in a pre-determined distance from the source, to be used in the dose estimate. The ACID computer program for pocket calculation allow to obtain the meteorological information to evaluate the dose. In this work the mathemathical models used and the program developed are described.

41255 (CNIC—00048) Environmental aspects of airborne radioactive effluent from a coal-fired power station. Song Miaofa; Fu Rongchu; Lu Zhizhao. (China Nuclear Information Centre, Beijing, BJ). 1987. 13p. (In Chinese). (SMC—0001). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702630/JAW.

The authors determined the contents of natural uranium and thorium in coal and tunnel ash samples taken from a large coal-fired power station in the nearby area. The hourly climate data in 1980 are analysed and the atmospheric stability is cataloged by Pasquill-Turner method. Wind direction-atmospheric stability-wind velocity combined probabilities and rain-wind direction probabilities are calculated. The near ground air pollution concentrations, the ground depositions and the distributions of U and Th presented in airborne effluent (fly ash) within an area round the station with a radius of 60 km are also estimated. In the calculations, some factors such as wind velocity in the higher atmosphere, plume rise, still wind and decrease of air pollution concentration by the ground deposition (especially the wet deposition porduced by rain) have been considered. Some corrections necessary for the factors described above are also made. It is shown that the maximum annual average air pollution concentration (U/sub max/ = 1.95 x 10/sup -7/ mg.m/sup -3/, Th/sub max/ = 3.45 x 10/sup -7/ mg.m/sup -3/) appears at the point 1 km away from the source in the fan SE. In the area round the station with a radius shorter than 10 km, the ground deposition is mainly by the wet deposition, but, where the radius longer than 10 km, the dry deposition must be taken into account.

41256 (DOE/ID/12584—15) Procedure manual for the estimation of average indoor radon-daughter concentrations using the Electronic Radon Progeny Integrating Sampling Unit (ERPISU) method. Pearson, M.D. (UNC Geotech, Grand Junction, CO (USA)). Mar 1988. Contract AC07-86ID12584. 44p. (UNC/GJ—39(TMC)). NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88008583/JAW.

One of the remedial action measurements needs is the estimation of average indoor radon-daughter concentration (RDC). One method for accomplishing such estimations is the Electric Radon Progeny Integrating Sampling Unit (ERPISU) method. Electronic RPISUs differ from standard RPISUs in that an Electronic RPISU measures radon-daughter concentrations using a solid-state alpha detector, rather than the thermoluminescent dosimeter employed by a standard RPISU. This procedure manual describes hoe to set up and operate a system for obtaining ERPISU measurements, and how to derive annual average RDC estimates from those measurements as well as RDC estimates for comparsion against selected standards. This manual contains both procedures specific to the Elberine WLM-1A Working Level Monitor and general guidelines applicable to any type of Electronic RPISU that may be approved by DOE. Necessary equipment items include samplers, readout units or computer interfaces, filters, radioactive alpha standard, and an airflow measuring device. The annula average radon-daughter

concentration is estimated as the mean of six such measurements, each approximately one week in duration and spaced approximately two months apart. Criteria for making fewer than six measurements, including the abbreviated RPISU method, and for handling missed or invalid measurements are also presented. 9 refs., 4 figs., 2 tabs.

41257 **(ES/ESH—4/V1) Environmental surveillance of the US Department of Energy Oak Ridge Reservation and surrounding environs during 1987: Volume 1: Narrative, summary, and conclusions.** Rogers, J.G.; Daniels, K.L.; Goodpasture, S.T.; Kimbrough, C.W.; Whitfield, E.W. (ed.). (Oak Ridge Y-12 Plant, TN (USA); Oak Ridge National Lab., TN (USA); Oak Ridge Gaseous Diffusion Plant, TN (USA)). Apr 1988. Contract AC05-84OR21400. 266p. NTIS, PC A12/MF A01;1; GPO Dep. Order Number DE88010746/JAW.

Comprehensive environmental monitoring data for 1987 show a continuation of progress in bringing the three major Oak Ridge installations into full compliance with permits and regulations issued by the bodies previously mentioned and with their advice and recommendations. Efforts to clean up contaminated storage and disposal areas and to close disposal sites that do not meet current standards are now the focus of long-term, large-scale remedial action efforts. Likewise, new and improved treatment and isolation systems for gaseous, liquid, and solid wastes contribute annually to continuing reductions in potentially harmful emissions and effluents from current operations. This measurable evidence provides a degree of confidence and assurance that the aggressive, long-term program of corrective actions and waste management improvements now under way will be successful in restoring and enhancing environmental quality in the future and in reducing the potential for any deleterious impacts on human health or the environment from current or past Oak Ridge operations. Volume 1 presents narratives, summaries, and conclusions based on environmental monitoring at the three DOE installations and in the surrounding environs during calendar year 1987. Volume 1 is intended to be a "stand-alone" report about the Oak Ridge Reservation (ORR) for the reader who does not want an in-depth review of 1987 data. Volume 2 presents the detailed data from which these conclusions have been drawn and should be used in conjunction with Volume 1.

41258 **(ES/ESH—4/V2) Environmental surveillance of the US Department of Energy Oak Ridge Reservation and surrounding environs during 1987: Volume 2, Data presentation.** Rogers, J.G.; Daniels, K.L.; Goodpasture, S.T.; Kimbrough, C.W.; Whitfield, E.W. (ed.). (Oak Ridge Y-12 Plant, TN (USA); Oak Ridge National Lab., TN (USA); Oak Ridge Gaseous Diffusion Plant, TN (USA)). Apr 1988. Contract AC05-84OR21400. 244p. NTIS, PC A11/MF A01;1; GPO Dep. Order Number DE88010747/JAW.

Comprehensive environmental monitoring data for 1987 show a continuation of progress in bringing the three major Oak Ridge installations into full compliance with permits and regulations issued by the bodies previously mentioned and with their advice and recommendations. Efforts to clean up contaminated storage and disposal areas and to close disposal sites that do not meet current standards are now the focus of long-term, large-scale remedial action efforts. Likewise, new and improved treatment and isolation systems for gaseous, liquid, and solid wastes contribute annually to continuing reductions in potentially harmful emissions and effluents from current operations. This measurable evidence provides a degree of confidence and assurance that the aggressive, long-term program of corrective actions and waste management improvements now under way will be successful in restoring and enhancing environmental quality in the future and in reducing the potential for any deleterious impacts on human health or the environment from current or past Oak Ridge operations. Volume 1 presents narratives, summaries, and conclusions based on environmental monitoring at the three DOE installations and in the surrounding environs during calendar year 1987. Volume 1 is intended to be a "stand-alone" report about the Oak Ridge Reservation (ORR) for the reader who does not want an in-depth review of 1987 data. Volume 2 presents the detailed data from which these conclusions have been drawn and should be used in conjunction with Volume 1.

41259 **(JAERI-M—88-016) Conversion factors for estimating release rate of gaseous radioactivity by an aerial survey.** Saito, Kimiaki; Moriuchi, Shigeru. (Japan Atomic Energy Research Inst., Tokyo). Feb 1988. 87p. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88753631/JAW.

Conversion factors necessary for estimating release rate of gaseous radioactivity by an aerial survey are presented. The conversion factors were determined based on calculation assuming a Gaussian plume model as a function of atmospheric stability, downwind distance and flight height. First, the conversion factors for plumes emitting mono-energy gamma rays were calculated, then, conversion factors were constructed through convolution for the radionuclides essential in an accident of a nuclear reactor, and for mixtures of these radionuclides considering elapsed time after shutdown. These conversion factors are shown in figures, and also polynomial expressions of the conversion factors as a function of height have been decided with the least-squares method. A user can easily obtain proper conversion factors from data shown here.

41260 **(JAERI-M—88-024) Results of atmospheric diffusion experiments, vol.3. TSUKUBA84, TSUKUBA85.** Kakuta, Michio; Hayashi, Takashi; Adachi, Takashi. (Japan Atomic Energy Research Inst., Tokyo). Feb 1988. 577p. (In Japanese). NTIS (US Sales Only), PC A25/MF A01. Order Number DE88754111/JAW.

An extensive study on 'Emergency monitoring and prediction code system' has been carried in JAERI since 1980. Six series of field experiments on atmospheric diffusion were conducted to develop and verify the prediction models for environmental concentration distribution following accidental release of radioactivity. Results of field experiments (Inland complex terrain, surface and elevated point sources) conducted in 15 - 19th October 1984 (TSUKUBA84) and in 6 - 10th November 1985 (TSUKUBA85) are contained in this volume.

41261 **(JAERI-M—88-061) Effectiveness of sheltering against internal exposure in nuclear reactor accidents, 3. Measurement of air flow resistance and wind pressure coefficient of house.** Noguchi, Hiroshi; Murata, Mikio; Kato, Shohei; Kokubu, Morinobu; Okuyama, Hiroyasu. (Japan Atomic Energy Research Inst., Tokyo). Mar 1988. 103p. (In Japanese). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88754129/JAW.

Sheltering is a simple and safe protection action for the general public living around nuclear facilities in an emergency such as a nuclear reactor accident. The reduction of internal exposure by sheltering directly depends on natural ventilation rates of houses. The coefficients and indexes of air flow resistance in small openings in the house and the wind pressure coefficients on outer periphery of the house are neccessary for calculation of the natural ventilation rate. This paper describes the method of measurement of these coefficients and indexes and the results. The coefficients and indexes of air flow resistance were measured for nine test pieces, for instance doors and windows, which were existing in a real reinforced concrete house chosen for the measurement and calculation of the natural ventilation rates, and 20 small opening models, which were expected to exisit in Japanese houses. The window pressure coefficients of the following three houses for various wind directions were measured using models of the houses: a real reinforced concrete house and Japanese one-story and two-story houses. The useful data for calculation of the natural ventilation rates of houses were obtained.

41262 **(PB—88-193313/XAB) Environmental Radiation Data: Report 49, January-March 1987. Final report.** (Environmental Protection Agency, Montgomery, AL (USA). Eastern Environmental Radiation Facility). Aug 1987. 44p. (EPA—520/5-87/018). NTIS, PC A03/MF A01.

See also PB—87-216149, and PB—88-194857.

Environmental Radiation Data (ERD) contains data from the Environmental Radiation Ambients Monitoring System (ERAMS). Data from similar networks operated by contributing States, Canada, Mexico and the Pan American Health Organization are reported in the ERD when available. The ERAMS is com-

prised of nationwide sampling stations that provide air, surface and drinking water, and milk samples from which environmental radiation levels are derived. Sampling locations are selected to provide optimal population coverage while functioning to monitor fallout from nuclear devices and other forms of radioactive contamination of the environment. The radiation analyses performed on these samples include gross alpha and gross beta levels, gamma analyses for fission products, and specific analyses for uranium, plutonium, stronium, iodine, radium, krypton, and tritium.

41263 **(PB—88-194832/XAB) Environmental Radiation Data: Report 50, April-June 1987. Final report.** (Environmental Protection Agency, Montgomery, AL (USA). Eastern Environmental Radiation Facility). Dec 1987. 45p. (EPA—520/5-88/001). NTIS, PC A03/MF A01.

See also PB—88-193313.

Environmental Radiation Data (ERD) contains data from the Environmental Radiation Ambients Monitoring System (ERAMS). Data from similar networks operated by contributing States, Canada, Mexico, and the Pan American Health Organization are reported in the ERD when available. The ERAMS is comprised of nationwide sampling stations that provide air, surface and drinking water, and milk samples from which environmental radiation levels are derived. Sampling locations are selected to provide optimal population coverage while functioning to monitor fallout from nuclear devices and other forms of radioactive contamination of the environment. The radiation analyses performed on these samples include gross alpha and gross beta levels, gamma analyses for fission products, and specific analyses for uranium, plutonium, stronium, iodine, radium, krypton, and tritium.

41264 **(PB—88-194857/XAB) Environmental Radiation Data: Report 48, October-December 1986. Final report.** (Environmental Protection Agency, Montgomery, AL (USA). Eastern Environmental Radiation Facility). Jun 1987. 54p. (EPA—520/5-87/017). NTIS, PC A04/MF A01.

See also PB—87-216149.

Environmental Radiation Data (ERD) contains data from the Environmental Radiation Ambients Monitoring System (ERAMS). Data from similar networks operated by contributing States, Canada, Mexico, and the Pan American Health Organization are reported in the ERD when available. The ERAMS is comprised of nationwide sampling stations that provide air, surface and drinking water, and milk samples from which environmental radiation levels are derived. Sampling locations are selected to provide optimal population coverage while functioning to monitor fallout from nuclear devices and other forms of radioactive contamination of the environment. The radiation analyses performed on these samples include gross alpha and gross beta levels, gamma analyses for fission products, and specific analyses for uranium, plutonium, stronium, iodine, radium, krypton, and tritium.

41265 **(PB—88-196159/XAB) New-construction techniques and HVAC (heating, venting and air conditioning) overpressurization for radon reduction in schools.** Witter, K.A.; Craig, A.B.; Saum, D. (Environmental Protection Agency, Research Triangle Park, NC (USA). Air and Energy Engineering Research Lab.). Apr 1988. 18p. (EPA—600/D-88/073). NTIS, PC A03/MF A01.

Construction of a school in Fairfax County, Virginia, is being carefully monitored since elevated indoor radon levels have been identified in many existing houses near the site. Soil-gas radon concentrations measured prior to pouring of the slabs were also indicative of a potential radon problem should the soil gas enter the school; however, subslab radon measurements collected thus far are lower than anticipated. In addition, the school's heating, ventilating, and air-conditioning (HVAC) system has been designed to operate continously in overpressurization to help reduce pressure-driven entry of radon-containing soil gas into the building. Following completion, indoor radon levels in the school will be monitored to determine the effectiveness of these radon-resistant new-construction techniques and HVAC overpressurization in limiting radon entry into the school.

41266 **(PB—88-196480/XAB) Radiological survey of Kings Bay Submarine Support Facility. Final report.** Windham, S.T. (Environmental Protection Agency, Montgomery, AL (USA). Eastern Environmental Radiation Facility). Oct 1987. 19p. (EPA—520/5-87/008). NTIS, PC A03/MF A01.

The Office of Radiation Programs identifies and evaluates environmental public health impacts of both natural and man-made radiation sources. The report presents results of the survey conducted by EERF personnel to assess levels of environmental radioactivity resulting from maintenance and operation of nuclear-powered warships at the Kings Bay Submarine Support Facility, Kingsland, Georgia. The purpose of the survey was to determine if activities related to nuclear-powered warships resulted in release of radionuclides that may contribute to significant population exposure or contamination of the environment.

41267 **(PB—88-196654/XAB) Radon reference manual. Final report.** (Office of Radiation Programs, Washington, DC (USA)). Sep 1987. 141p. (EPA—520/1-87/20). NTIS, PC A07/MF A01.

This manual follows the question-and-answer format presented in the EPA pamphlet A Citizens Guide to Radon. Each section of the manual provides a more-detailed discussion of the issues underlying each section of the pamphlet and cites the sources of information used by EPA to formulate each answer. In addition, the derivations of certain estimates (such as total lung cancer deaths and radon risk levels) are explained to allow comparison between EPA's methodology and other approaches presented in scientific literature.

41268 **(PB—88-198528/XAB) Clinton, New Jersey, radon mitigation follow-up and long-term monitoring. Final report, January-October 1987.** Carvitti, J. (PEI Associates, Inc., Cincinnati, OH (USA)). Apr 1988. 62p. NTIS, PC A04/MF A01.

See also PB—87-191557.

This report gives results of a follow-up of the 1986 demonstration of radon-reduction techniques in 10 houses in Clinton, New Jersey. Initial radon levels in the 10 houses ranged from 400 to 2200 pCi/1. Radon reductions of more than 95% were achieved by using a variety of subslab ventilation techniques. Since January 1987, the radon levels in the 10 houses have been monitored with alpha-track detectors. The detectors were installed and removed quarterly. Three detectors were used on the lowest level of each house, and three on the next higher level. Results of the comparison between the radon concentration measured during the first and second quarters of 1987 showed that most of the houses had slightly higher concentrations during the second quarter. These results are contrary to expected trends. Two houses with slightly elevated radon levels received additional radon-reduction applications at the end of the second quarter of 1987: in one house, the radon concentration was successfully reduced, and in the other, the concentration was essentially unchanged.

41269 **(PB—88-864756/XAB) Continuous and passive environmental radon monitoring: concentrations, measuring instruments, and health effects. January 1975-May 1988 (Citations from the INSPEC: Information Services for the Physics and Engineering Communities data base). Report for January 1975-May 1988.** (National Technical Information Service, Springfield, VA (USA)). May 1988. 139p. NTIS PC N01/MF N01.

This bibliography contains citations concerning continuous and passive radon (Rn) and Rn daughters concentration monitoring, measuring methods, equipment, and related health effects in air, water, and soils. The design, development, and evaluations of Rn monitoring and detection devices are presented, including alpha spectroscopy and dosimetry, track detecting and scintillation, thermoluminescent, electret, and electrode collection. Sources of Rn concentration levels found in building materials, ventilation systems, soils, and ground water are considered. Lung-cancer associated risks from Rn radiation exposure are examined. Radon monitoring in mining operations is excluded. (Contains 282 citations fully indexed and including a title list.)

41270 (SCPRI-RM—10-1987) Monthly results of measurements, October 1987. (Service Central de Protection contre les Rayonnements Ionisants, 78 - Le Vesinet (France)). Oct 1987. 43p. (In French). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88753978/JAW.

This report of the SCPRI exposes an interpretation of the principal results concerning the routine monitoring of environmental radioactivity in France: atmospheric dusts, rainwater, surface waters, underground water, drinking water, sewage water, food chain (milk, vegetables, fishes), seawater around nuclear plant sites and other sites, sediments. The activities of various radioisotopes are presented in tables. This report exposes also the results of special radiation measurements resulting from the Chernobyl accident.

41271 (SCPRI-RM—11-1987) Monthly results of measurements, November 1987. (Service Central de Protection contre les Rayonnements Ionisants, 78 - Le Vesinet (France)). Nov 1987. 44p. (In French). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88753979/JAW.

This report of the SCPRI exposes an interpretation of the principal results concerning the routine monitoring of environmental radioactivity in France: atmospheric dusts, rainwater, surface waters, underground water, drinking water, sewage water, food chain (milk, vegetables, fishes), sea water around nuclear plant sites and other sites, sediments. The activities of various radioisotopes are presented in tables. This report exposes also the results of special radiation measurements resulting from the Chernobyl accident.

41272 (UCRL—98348) Internal dose following a large-scale nuclear war. Peterson, K.R.; Shapiro, C.S.; Harvey, T.F. (Lawrence Livermore National Lab., CA (USA)). Mar 1988. Contract W-7405-ENG-48. 96p. (CONF-880367—2). NTIS, PC A05/MF A01;1; GPO Dep. Order Number DE88008033/JAW.

From SCOPE-ENUWAR workshop on the environmental consequences of nuclear war; Moscow, USSR (20 Mar 1988).

In this study, we use the PATHWAY model, in conjunction with a reasonable hypothetical nuclear attack on the US to arrive at calculations of internal and external dose estimates that are based on valid model results. Our own estimates are presented with calculational aids (at every step) that enable readers to use their own nuclear war scenarios, fallout patterns, assumptions about the climatic changes brought on by large fires following a nuclear attack, the viability of the transportation system for food delivery, the quality and quantity of water and foods available locally, the required caloric intakes of the survivors, and several other factors. We conclude that the average American family that survived a large-scale nuclear war, using their own home or workplace as a refuge, would receive a total internal dose from ingestion that is from one to 10 percent of the total external dose. Those who stayed where shelter protection factors and foraged food consumption were large could receive internal doses from 11 percent to more than 100% of the total external dose. 28 refs., 9 figs.

41273 Modeling the effects of exhaust ventilation on ^{222}Rn entry rates and indoor ^{222}Rn concentrations. Mowris, R.J.; Fisk, W.J. (Lawrence Berkeley Lab., CA (USA)). *Health Physics;* **54**: No. 5, 491-501(May 1988).

Continuous mechanical exhaust ventilation of moderately airtight residences is common in Scandinavia and has recently been employed in several U.S. residences. Exhaust ventilation decreases the indoor pressure and, thus, increases the pressure difference which drives ^{222}Rn entry. Relatively simple analytical (i.e. closed form) models were developed and used to examine the impacts of exhaust ventilation on ^{222}Rn entry rates and concentrations in houses with either a crawl space or a basement. A more complex finite difference model was also developed for the house with a basement and yielded soil gas entry rates within 16% of those predicted with the analytical model. The models indicate that exhaust ventilation is suitable, but not optimal (from the perspective of indoor ^{222}Rn), for houses with a vented crawl space. Exhaust ventilation is also indicated to be suitable for houses with basements surrounded by relatively impermeable soil (10(-12) m2 or less). If soil permeabilities are between 10(-12) and 10(-10) m2, exhaust ventilation may cause substantial increases in indoor ^{222}Rn when soil gas ^{222}Rn concentrations are above average. If soil permeabilities are greater than 10(-10) m2, exhaust ventilation is indicated to be inappropriate, unless some procedure is employed to inhibit soil gas entry. These conclusions should be considered tentative, since extensive verification of the models is still required.

41274 Interview: radon research. Sextro, R. (Lawrence Berkeley Lab., CA (USA)). *Energy Auditor and Retrofitter;* **4**: No. 5, 5-9(Sep-Oct 1987).

In this interview, Dr. Richard Sextro, Lawrence Berkeley Lab., discusses the following aspects of the indoor radon problem: is it a critical health issue; its history; effectiveness of weatherization programs on control; sources; highest levels found; most successful mitigation techniques; leak-sealing effectiveness; seasonal variations; and EPA's measurement protocols. He notes that radon is indeed a significant indoor pollutant, and their basis for concern is more certain than for most chemicals. Further, unlike most other indoor pollutants, the radon source is primarily external and infiltrates. Dr. Sextro discusses briefly their study of 7 houses in north-central New Jersey: most of the houses in the study had concentrations in the 50 to 100 pico curies/liter range; the 7th house, a control house showed 20-30 pCi/l in the basement, and in July they installed a mitigation system that reduced levels below 2 pCi/l. He also discusses misconceptions about EPA's 4 pCi/l guideline and their requirement for accuracy to within 25% for the radon monitors. One thing they are examining at present is measurement techniques for summer time use that would involve a blower door to depressurize the house.

5004 Thermal Effluents Monitoring And Transport

REFER ALSO TO CITATION(S) 41333, 41334

5005 Site Resource And Use Studies

REFER ALSO TO CITATION(S) 40162

5006 Regulations

REFER ALSO TO CITATION(S) 39098, 40231, 41170, 41171, 41173, 41174, 41175, 41241, 41274, 41395

41275 (GAO/RCED—85-121) EPA's sanctions policy is not consistent with the Clean Air Act. (General Accounting Office, Washington, DC (USA)). 1985. 37p. General Accounting Office, PO Box 6015, Gaithersburg, MD 20877.

"GAO recommends that the EPA Administrator either (1) develop and implement a policy to provide sanctions for areas not attaining air quality standards by the deadlines specified in the Clean Air Act or (2) seek legislative relief from the applicable clean Air Act provisions which, in GAO's view, require imposition of such sanctions.

41276 (PB—88-150032/XAB) Hazardous-waste enforcement in Illinois, Fiscal Year 1986. Report for 1 July 1985-30 June 1986. Svoboda, J.; Muraro, J. (Illinois Environmental Protection Agency, Springfield (USA). Enforcement Programs). Nov 1987. 94p. (IEPA/ENF—87-018). NTIS, PC A05/MF A01.

See also report dated Jul 86, PB—86-224771.

A brief overview of enforcement policies and procedures by the Illinois Environmental Protection Agency, particularly as they involve violations concerning hazardous wastes or materials, and the various enforcement options available to IEPA to secure compliance.

41277 (PB—88-190483/XAB) Review of methods for remote sensing of atmospheric emissions from stationary sources. Final report. Saeger, M.L.; Sokol, C.K.; Coffey, S.J.; Wright, R.S.; Farthing, W.E. (Research Triangle Inst., Research Triangle Park, NC (USA)). Mar 1988. 98p. (RTI—3744/04-01F). NTIS, PC A05/MF A01.

This report reviews the commercially available and developing technologies for the application of remote sensing to the measurement of source emissions. The term remote sensing technology, as applied in the report, means the detection or concentration measurement of trace atmospheric species by sensing the interaction of propagating electromagnetic energy and the specific constituent along the path of propagation. Many remote-monitoring techniques are applicable to source measurements. The source of the energy can be natural or designed as part of the system. In general, passive techniques are easier to use and less expensive to purchase and operate than are the active systems. Active systems are, in general, more specific and more sensitive than the passive systems. Some active techniques provide the added advantage of range resolution, which is preferred for some types of measurement applications.

41278 **(PB—88-193255/XAB) Chemicals subject to reporting under the Emergency Planning and Community Right to Know Act (Title 3 of the Superfund Ammendments and Reauthorization Act of 1986), January 1988 (for microcomputers). Data file.** Pratt, L. (Environmental Protection Agency, Washington, DC (USA). Office of Toxic Substances). Jan 1988. vp. (EPA—560/4-88/003). NTIS CP D01.

The data file is contained on 5 1/4-inch, double sided, double density diskettes, compatible with the IBM PC microcomputer. The diskettes are in the DBASE III format.

This is the disk-based version of the Office of Toxic Substances' consolidated list of chemicals subject to reporting under Title III of the Superfund Amendments and Reauthorization Act of 1986 (SARA). Title III is also known as the Emergency Planning and Community Right to Know Act. The document is a list of all chemicals subject to reporting under sections 302, 304, and 313 of Title III. The disk is designed to generate either a printout or a dbase III file from any IBM or IBM compatible system.

41279 **(PB—88-196357/XAB) National air-audit-system guidance manual for FY 1988 - FY 1989.** (Environmental Protection Agency, Research Triangle Park, NC (USA). Office of Air Quality Planning and Standards). Feb 1988. 343p. (EPA—450/2-88/002). NTIS, PC A15/MF A01.

The purpose of developing national air-audit-system guidelines is to establish standardized criteria for EPA Regions to follow when auditing State air-program activities. The document, prepared jointly by the State and Territorial Air Pollution Program Administrators (STAPPA), the Association of Local Air Pollution Control Officials (ALAPCO), and the Environmental Protection Agency, provides national air-audit guidelines for air-quality planning and SIP activities, new source review, compliance assurance, monitoring, and vehicle inspection and maintenance programs.

41280 **(PB—88-197298/XAB) Chromium emissions from comfort cooling towers: background information for proposed standards. Draft environmental impact statement (Final).** (Environmental Protection Agency, Research Triangle Park, NC (USA). Office of Air Quality Planning and Standards). Mar 1988. 171p. (EPA—450/3-87-010A). NTIS, PC A08/MF A01.

Standards of performance for the control of hexavalent chromium emissions from comfort cooling towers are being proposed under authority of Section 6 of the Toxic Substances Control Act. These standards would apply to existing and new comfort cooling towers. The document contains background information and environmental- and economic-impact assessments of the regulatory alternatives considered in developing the proposed standards.

41281 **(PB—88-197603/XAB) EPA (Environmental Protection Agency) activities under the Resource Conservation and Recovery Act of 1976. Annual report to the President and the Congress, Fiscal Year 1977.** (Environmental Protection Agency, Washington, DC (USA). Office of Solid Waste). Feb 1978. 88p. (EPA—530/SW-663). NTIS, PC A05/MF A01.

This report to the President and Congress is the Environmental Protection Agency's (EPA) first annual report on its activities under the Resource Conservation and Recovery Act of 1976 (RCRA). It summarizes in detail the programs for FY 1977 and outlines solid-waste problems, program objectives, legislative considerations, and plans for FY 1978.

41282 **(PB—88-202510/XAB) Identification of Subpart Da sources and EPA (Environmental Protection Agency) regional/state agency contacts for the implementation of Appendix F: Procedure 1.** Peeler, J.W. (Entropy Environmentalists, Inc., Research Triangle Park, NC (USA)). Mar 1988. 21p. NTIS, PC A03/MF A01.

See also PB—83-161646.

Appendix F, Procedure 1, Quality Assurance Requirements for Gaseous Continuous Emission Monitoring Systems Used for Compliance, of 40 CFR 60 requires that sources subject to Standards of Performance for New Stationary Sources, Subpart Da conduct certain quality-assurance activities and submit a Data Assessment Report (DAR) on a quarterly basis to the applicable control agency. This report presents a list of all electric-utility steam-generating units that are believed to be subject to Subpart Da. The list indicates the status of each unit (i.e., currently operating, under construction, or planned), and also provides source-contact information. In addition, this report identifies the state agency contacts who are believed to be responsible for review of the DAR's. A list of EPA Regional Office contacts is also provided.

41283 **(PB—88-211917/XAB) Overview of controls for chlorofluorocarbons.** Harmon, D.L.; Rhodes, W.J. (Environmental Protection Agency, Research Triangle Park, NC (USA). Air and Energy Engineering Research Lab.). May 1988. 14p. (EPA—600/D-88/100). NTIS, PC A03/MF A01.

This paper gives an overview of controls for chlorofluorocarbons (CFCs). Responding to concerns regarding the potential for stratospheric ozone depletion, the U.S. has joined other nations in pursuing an international agreement to limit the emissions of fully halogenated CFCs and certain halons. To implement the Montreal Protocol in the U.S., the EPA has proposed a national regulation to limit the production of these substances by the allocation of production quotas to firms engaged in this activity in 1986. Many ways exist to achieve the needed reductions. The paper discusses the various control options with some advantages and disadvantages, for the major industries that use CFCs and halons.

51 ENVIRONMENTAL SCIENCES, TERRESTRIAL

REFER ALSO TO CITATION(S) 40009

41284 **(IC—87/391) Investigation of the variation of the specific heat capacity of local soil samples from the Niger delta, Nigeria with moisture content.** Ofoegbu, C.O.; Adjepong, S.K. (Port Harcourt Univ. (Nigeria). Dept. of Physics). (International Centre for Theoretical Physics, Trieste (Italy)). Nov 1987. 9p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88703001/JAW.

Results of an investigation of the variation, with moisture content, of the specific heat capacity of samples of three texturally different types of soil (clayey, sandy and sandy loam) obtained from the Niger delta area of Nigeria, are presented. The results show that the specific heat capacities of the soils studied, increase with moisture content. This increase is found to be linear for the entire range of moisture contents considered (0-25%), in the case of the sandy loam soil while for the clayey and sandy soils the specific heat capacity is found to increase linearly with moisture content up to about 15% after which the increase becomes parabolic. The rate of increase of specific heat capacity with moisture content appears to be highest in the clayey soil and lowest in the sandy soil. It is thought that the differences in the rates of increase of specific heat capacity with moisture content, observed for the soils, reflect the soils' water-retention capacities. (author) 3 refs, 5 figs.

5101 Basic Studies

REFER ALSO TO CITATION(S) 39500, 41312, 41329, 41338, 41342

41285 (ANSTO/E—666) Mathematical study of a lysimeter. Gibson, D.K. (Australian Nuclear Science and Technology Organisation, Lucas Heights). Nov 1987. 13p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703092/JAW.

In studies of the rehabilitation of mine overburden heaps at Rum Jungle in the Northern Territory of Australia, simple buried water collectors have been used as lysimeters to measure the infiltration into the heaps. This report describes the development and results of a study state finite difference computer code which calculates the movement of water in such systems. It is shown that the water collection efficiency of this type of lysimeter depends strongly on the hydraulic properties of the soil in which it is buried, as does the rate of capillary loss during periods of zero infiltration.

41286 (CONF-8804140—3) Nutrient-use efficiency as an indicator of stress effects in forest trees. Luxmoore, R.J. (Oak Ridge National Lab., TN (USA)). 1988. Contract AC05-84OR21400. 23p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88011404/JAW.

From National Research Council workshop on biological markers of air pollution exposure in trees; Little Switzerland, NC, USA (25 Apr 1988).

The ratio of dry weight gain to net nutrient uptake is one definition of nutrient-use efficiency (NUE). Another definition is given by the ratio of dry weight gain to nutrient content and for some tissues such as leaves, NUE is the reciprocal of nutrient concentration since leaf dry weight is the dry weight gain, and the nutrient content is the net nutrient uptake. Consideration of the utility of nutrient-use efficiency as an indicator of stress effects requires evaluation of stress effects on the relative dynamics of carbon gain and nutrient acquisition. A hyperbolic function describes the expected relationship between carbon gain and nutrient uptake up to the maximum carbon gain (M), where the increment in carbon gain (ΔC) per increment of nutrient uptake (ΔN) is zero. The optimum carbon gain (0) is defined as the point at which the second derivative of the function is zero. In field situations, plants typically operate at about half the maximum rate of carbon gain (T). An approximately linear section of the relationship between L and the typical point (T) has one NUE value ($\Delta C/\Delta N$). Approaching the origin, NUE reaches the highest value (H); however, this condition is associated with abnormally weak or drying plants! Although high NUE may be an indicator of extreme stress, it does not provide an early warning. 27 refs., 8 figs.

41287 (DOE/ER/60426—1) An experimental analysis of granivory in desert ecosystems. Davidson, D.W. (Utah Univ., Salt Lake City (USA). Dept. of Biology). 1988. Contract FG02-86ER60426. 7p. NTIS, PC A02;3. Order Number DE88011584/JAW.

In our studies of desert granivore ecology, we have outlined the network of interaction pathways linking granivore and resource species in a Chihuahuan Desert Ecosystem. Here, a major fraction of the primary productivity takes the form of the seeds of annual plants. These seeds support two major resident taxa of desert granivores, ants and rodents. Population responses to removal of various taxa of granivores or seasonal classes of resource species are described.

41288 (DOE/ER/60470—02) Hypotheses testing of watershed/landscape dynamics in Northern Alaska using digital analysis: [Annual progress report]. (Pennsylvania State Univ., University Park (USA). Environmental Resources Research Inst.). [1988]. Contract FG02-86ER60470. 5p. NTIS, PC A02/MF A01;1; GPO Dep. Order Number DE88009213/JAW.

This research project involves the study of ecosystem dynamics near Toolik Lake in the North Slope region of Alaska. The primary goals are to: 1) evaluate the feasibility of using advanced remote sensing and digital database processing techniques to identify and measure landscape components important in land disturbance processes, and 2) establish and quantify spatial interrelationships between landform geometry (i.e., elevation, slope, and slope aspect) and ecologically important features such as vegetation and snow distributions, solar insolation, and depth to active layer.

41289 (JINR-E—14-87-345) Neutronographic fabric analysis of quartz in naturally deformed gneiss. Drechsler, L.P.; Feldmann, K.; Walther, K.; Frischbutter, A. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics; Akademie der Wissenschaften der DDR, Potsdam. Zentralinstitut fuer Physik der Erde). (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics). 1987. 10p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88703371/JAW.

Submitted to the journal Texture and Microstructures.

The crystalline preferred orientations of quartz grains in columnar gneiss from the Erzgebirge (southern GDR) are studied by means of neutron time-of-flight diffraction. A single component texture has been found where the trigonal axes are parallel to the tectonic a-direction. In the quartz c-axis pole figure strong maxima at +-a are related to a gridle of weak intensity being found in optical measurements. From the comparison of expreimentally deformed quartizites and model calaculations the conclusion is made on the approximate conditions of formation of columnar gneiss. 16 refs.; 12 figs.; 1 tab.

5102 Chemicals Monitoring And Transport

REFER ALSO TO CITATION(S) 39106, 39111, 39623, 40012, 40488, 40502, 40519, 41162, 41224, 41310, 41317, 41334, 41349, 41357, 41358

41290 (AD-A—190451/5/XAB) Installation Restoration Program. Phase 2. Confirmation/quantification. Stage 1. Air Force Plant 6, Cobb County, Georgia. Volume 1. Final draft report, May 1984-August 1985. Neff, C.R.; Cross, T.L.; Bruderly, D.E.; Brislin, T.A.; Spiers, C.A. (Environmental Science and Engineering, Inc., Gainesville, FL (USA)). 9 Aug 1986. 241p. (ESE-IRP-IIA-AFP—6-VOL-1). NTIS, PC A11/MF A01.

See also Volume 2, AD-A190 452.

A Phase II, Stage 1 Installation Restoration Program was conducted for Air Force Plant 6, a Government-owned, contractor-operated facility run by Lockheed-Georgia Co. The objective of this study is to confirm the existence of potential contaminants at former and current disposal and storage sites identified by a Phase I Records Search and by Lockheed-Georgia Co-sponsored environmental site assessments. Sixteen sites were investigated, including past and current landfills; the industrial-waste-treatment facility area; trichloroethylene (TCE), sodium dichromate, and fuel-gas spill areas; the flightline area, and specific areas of contamination within the industrial facility.

41291 (AD-A—190452/3/XAB) Installation Restoration Program. Phase 2. Confirmation/quantification. Stage 1. Air Force Plant 6, Cobb County, Georgia. Volume 2. Final draft report, May 1984-August 1985. Neff, C.R.; Cross, T.L.; Bruderly, D.E.; Brislin, T.A.; Spiers, C.A. (Environmental Science and Engineering, Inc., Gainesville, FL (USA)). 9 Aug 1986. 191p. (ESE-IRP-IIA-AFP—6-VOL-2). NTIS, PC A09/MF A01.

See also Volume 3, AD-A190 453.

A Phase II, Stage 1 Installation Restoration Program was conducted for Air Force Plant 6, a Government-owned, contractor-operated facility run by Lockheed-Georgia Co. The objective of this study is to confirm the existence of potential contaminants at former and current disposal and storage sites identified by a Phase I Records Search and by Lockheed-Georgia Co.-sponsored environmental site assessments. Sixteen sites were investigated, including past and current landfills; the industrial-waste-treatment-facility area; trichloroethylene (TCE), sodium dichromate, and fuel-gas spill areas; the flightline area, and specific areas of contamination within the industrial facility.

41292 **(AD-A—190453/1/XAB) Installation Restoration Program. Phase 2. Confirmation/quantification. Stage 1. Air Force Plant 6, Cobb County, Georgia. Volume 3. Final draft report, May 1984-August 1985.** Neff, C.R.; Cross, T.L.; Bruderly, D.E.; Brislin, T.A.; Spiers, C.A. (Environmental Science and Engineering, Inc., Gainesville, FL (USA)). 9 Aug 1986. 452p. (ESE-IRP-IIA-AFP—6-VOL-3). NTIS, PC A20/MF A01.

See also Volume 1, AD-A190 451.

A Phase II, Stage 1 Installation Restoration Program was conducted for Air Force Plant 6, A Government-owned, contractor-operated facility run by Lockheed-Georgia Co. The objective of this study is to confirm the existence of potential contaminants at former and current disposal and storage sites identified by a Phase I Records Search and by Lockheed-Georgia Co.-sponsored environmental site assessments. Sixteen sites were investigated, including past and current landfills; the industrial-waste-treatment-facility area; trichloroethylene (TCE), sodium dichromate, and fuel-gas spill areas; the flightline area, and specific areas of contamination within the industrial facility.

41293 **(AD-A—190797/1/XAB) Terrestrial microcosm evaluation of two Army smoke-producing compounds. Final report, 15 December 1983-14 March 1985.** Tolle, D.A.; Arthur, M.F.; Chesson, J.; Duke, K.M.; Jackson, D.R. (Battelle Columbus Labs., OH (USA)). 29 Jan 1988. 151p. NTIS, PC A08/MF A01.

An intact soil-core microcosm and static exposure system were used to evaluate the potential ecological effects of two obscurant smokes--red phosphorus/butyl rubber (RP/BR) and white phosphorus/felt (WP/F), used by the U.S. Army in training exercises. Three plant species (white sweetclover, perennial rye-grass, and wheat) where chosen for preliminary and microcosm tests, because they have wide geographic distributions, can be used to reclaim disturbed ground, are different physiologically and morphologically, and were shown to be capable of field representative growth in the small surface area of the microcosms. The preliminary stress-ethylene tests indicated that extremely high doses of either smoke would be required to elicit a response in the microcosm test. Minor ecosystem effects were detected only at the highest smoke concentration, including increased nutrient (Ca) loss in leachate, increased (wheat) or decreased (sweetclover) biomass yield, and increased element (Al, As, Pb, and P) uptake in plant tissue. Even the highest smoke concentrations did not affect soil microorganism respiration. No negative ecological effects of either smoke were detected at smoke concentrations equal to or below 600 mg/cubic meter, even for semiweekly exposures over an 8-week period. It was concluded that deployment of these two smokes at or below the above concentration and frequency was possible without significant problems to most terrestrial systems.

41294 **(CH2MH—EE91) Steam stripping as an emergency countermeasure.** (CH2M Hill Canada Ltd., Mississauga, Ontario). Nov 1987. 99p. (MICROLOG—88-02062). Environmental Protection Directorate, Environment Canada, 351 St. Joseph Blvd., Terrasses de la Chaudiere, Ottawa, Ont., Canada K1A 0E7; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

A preliminary assessment was made of the technical, logistical and economic feasibility of a mobile steam stripping unit for treating contaminated groundwater resulting from spills and containing volatile organic compounds. Most candidate priority pollutants reviewed are steam strippable. Three alternate process schemes, namely, open steam, reboiling, and vapor compression evaporation, were evaluated. A computer model was used to calculate mass transfer efficiencies for seven selected pollutants. The unit at a design flow of 2000 l/h was investigated and was found to fit within the overall length of a box van, i.e. 4.88 m. The economic analysis concluded that a capital expenditure in the vicinity of $154,000 is required. Daily operating cost of such a unit would be approximately $850/day, transportation and set-up/dismantling time not included. 60 refs., 4 figs., 7 tabs.

41295 (EC—1988, pp 81-95) **Canadian directory of PCB service companies.** [1988]. Infotech, Ste. 200, 1015 Centre St., N., Calgary, Alta., Canada T2E 2P8; $35.00 Can. (CE—01766; CONF-8706323—).

From Underground storage tank technology; Moncton, Canada (15 Jun 1987).

This directory includes companies and government agencies in Canada that are involved with polychlorinated biphenyls, including services such as chemical analysis sampling, and monitoring, hazardous spill cleanup, treatment, decontamination, and site rehabilitation, risk assessment and contingency planning, replacement of PCB-contaminated oils; transport and storage, environmental analysis, waste management, liability insurance, safety equipment, engineering consulting, occupational hygiene, and government regulation.

41296 (GQ/ME—1988, pp 97-114) **Hazardous waste management. The Alberta Model.** Richardson, J.S. (Chem-Security Ltd., Canada). 1988. Environment Canada, Publications Section, Terrasses de la Chaudiere, Ottawa, Ont., Canada K1A 043; $N/C. (MICROLOG—88-03825; CONF-8804158—).

From 3. conference on toxic substances; Montreal, Canada (6 Apr 1988).

Industry and government in Alberta have achieved success in the technology and capability to handle hazardous waste and the ability to deal with this issue from a social and political perspective. Alberta is the first jurisdiction in North America to host a fully comprehensive special waste management system which has, as its centerpiece, an integrated special waste treatment centre or facility, operational in part since November 1986. This report describes the facility and the waste management system. This system includes a gathering or collection system that is the initial interface between the overall system and the generator of the waste and includes two transfer stations servicing the larger communities of Calgary and Edmonton, and a transportation network connecting the collection system to the waste treatment facility. The treatment centre is described with respect to its design criteria, processes used, major components (including a high temperature incinerator, storage tanks and landfill sites, physical/chemical treatment plant, stabilization/solidification plant, and injection deepwells) and air pollution standards. 8 figs.

41297 **(OH/RD—87/273/K) Canada Brick Quarry Ground Water Survey 6th annual report, 1986-1987.** Quarshie, E. (Ontario Hydro Research Div., Toronto (Canada)). 10 Dec 1987. 147p. (MICROLOG—88-02028). Ontario Hydro Research Division, Editorial Section, 800 Kipling Ave., Toronto, Ont., Canada M8Z 5S4; $10.00 CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

Analytic data on ground water samples collected from boreholes in and around the Canada Brick Quarry fly ash disposal site (Mississauga, Ontario) are reported. Piezometric head measurements, chemical analyses of ground water, major ion balances and Piper diagrams are included. Most of the report consists of numerical data. Effect of fly ash leachate on water quality is discussed.

41298 **(OH/RD—87/283/K) Canada Brick Quarry Surface Water Survey. 6th annual report, 1987.** Quarshie, E. (Ontario Hydro Research Div., Toronto (Canada)). 14 Dec 1987. 38p. (MICROLOG—88-02029). Ontario Hydro Research Division, Editorial Section, 800 Kipling Ave., Toronto, Ont., Canada M8Z 5S4; $10.00 CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

Since December 1981, fly ash from Lakeview Thermal Generating Station has been disposed of as landfill at Canada Brick Quarry, Mississauga, Ontario. Environmental policies require regular monitoring of local surface water and ground water in and around the Canada Brick Quarry property. This report presents data on chemical analysis of surface water samples, stream flow, major ion balances and Pier diagrams. Effect of fly ash leachate on surface water is discussed. The bulk of this report consists of numerical data.

41299 **(PB—88-186291/XAB) Fiscal Year 1986 program report: Maine Land and Water Resources Center.** White, G.K. (Maine Univ., Orono (USA). Land and Water Resources Inst.). Jul 1987. 26p. NTIS, PC A03/MF A01.

See also report for FY 85, PB—87-166013.

Four research projects and an information transfer component were funded under the Maine FY-86 program: An Investigation into the Effects of Site Disturbance on the Mobilization of Accumulated Trace Metals from Forest Floors and the Implications for Groundwater Quality (G1229-02); Terrestrial Versus In-stream Sources of Dissolved Aluminum During Episodic Low pH Events (G1229-03); Reduction of Nitrate Contamination of Groundwater by Septic Tank Effluent (G1229-04); Probabilistic Model for Flow in Fissured Bedrock (G1229-05); and Information Transfer in Water Resources Management (G1229-22).

41300 **(PB—88-195540/XAB) Interactive simulation of the fate of hazardous chemicals during land treatment of oily wastes: RITZ (Regulatory and Investigative Treatment Zone) user's guide. Final report, May 1986-November 1987.** Nofziger, D.L.; Williams, J.R.; Short, T.E. (Oklahoma State Univ., Stillwater (USA). Dept. of Agronomy). Jan 1988. 68p. NTIS, PC A04/MF A01.

For system on diskette, see PB—88-195532.

An interactive software system was developed to enable decision makers to simulate the movement and fate of hazardous chemicals during land treatment of oily wastes. The mathematical model known as the Regulatory and Investigative Treatment Zone Model, or RITZ, was developed and published earlier by Short(1985). The model incorporates the influence of oil in the sludge, water movement, volatilization, and degradation upon the transport and fate of a hazardous chemical. The manual describes the conceptual framework and assumptions used by Short (1985) in developing the model. It then explains the microcomputer hardware and software requirements, the input parameters for the model, and the graphical and tabular outputs which can be selected. Illustrations of the use of the software are also included. The computational equations developed by Short (1985) are presented for completeness but are not derived.

41301 **(PB—88-195649/XAB) Use of flexible membranes in protection of ground water.** Landreth, R.E. (Environmental Protection Agency, Cincinnati, OH (USA). Hazardous Waste Engineering Research Lab.). Apr 1988. 18p. (EPA—600/D-88/060). NTIS, PC A03/MF A01.

Flexible membrane liners are increasingly being used to prevent leachate and other waste fluids generated at landfills, surface impoundments, and waste piles from entering the ground water. This paper describes the EPA's research program on treatment, storage, and disposal facilities with emphasis on containment systems. The paper will identify landfill construction concerns and potential solutions to those concerns.

41302 **(PB—88-198544/XAB) Development of a qualitative pathogen risk-assessment methodology for municipal-sludge landfilling.** (Environmental Protection Agency, Cincinnati, OH (USA). Office of Environmental Criteria and Assessment). Apr 1988. 171p. (EPA—600/6-88/006). NTIS, PC A08/MF A01.

This report addresses potential risks from microbiological pathogens present in municipal sludge disposal in landfills. Municipal sludges contain a wide variety of bacteria, viruses, protozoa, helminths, and fungi. Survival characteristics of pathogens are critical factors in assessing the risks associated with potential transport of microorganisms from the sludge-soil matrix to the ground-water environment of landfills. Various models are discussed for predicting microbial die-off. The order of persistence in the environment from longest to shortest survival time appears to be helminth eggs > viruses > bacteria > protozoan cysts. Whether or not a pathogen reaches ground-water and is transported to drinking-water wells depends on a number of factors, including initial concentration of the pathogen, survival of the pathogen, number of pathogens that reach the sludge-soil interface, degree of removal through the unsaturated and saturated-soil zones, and the hydraulic gradient. The degree to which each of these factors will influence the probability of pathogens entering ground-water cannot be determined precisely. Information on the fate of pathogens at existing landfills is sorely lacking. Additional laboratory and field studies are needed to determine the degree of pathogen leaching, survival and transport in ground-water in order to estimate potential risks from pathogens at sludge landfills with reasonable validity.

41303 **(PB—88-200795/XAB) Causes of wetland loss in the coastal central Gulf of Mexico.** (Louisiana State Univ., Baton Rouge (USA). Center for Wetland Resources). Jan 1988. 580p. NTIS, PC E99.

Set includes PB—88-200803 through PB—88-200829.

A separate abstract is included for each of the 3 reports of this set.

41304 **(PB—88-200803/XAB) Causes of wetland loss in the coastal Gulf of Mexico, Volume 1; executive summary. Final report.** Turner, R.E.; Cahoon, D.R. (Louisiana State Univ., Baton Rouge (USA). Center for Wetland Resources). Jan 1988. 40p. NTIS, PC A03/MF A01.

See also Volume 2, PB—88-200811; Also available in set of 3 reports, PC E99, PB—88-200795.

In 1985, the Minerals Management Service initiated an investigation to study the causes of wetland loss in the coastal Gulf of Mexico as part of its Outer Continental Shelf environmental-studies program. The purpose of the two-year study was to investigate the factors that contribute to wetland loss and to determine specifically what percentage of the loss is directly and indirectly related to Federal offshore oil and gas development. The primary goal of the Coastal Effects Program is to delineate the onshore impacts of offshore oil and gas development activities. The final report, prepared in three volumes, describes the extent of the contribution of OCS development to coastal land loss. Volume I is the Executive Summary. The report provides a detailed description of both direct and indirect impacts.

41305 **(PB—88-200811/XAB) Causes of wetland loss in the coastal central Gulf of Mexico. Volume 2. Technical narrative. Final report.** Turner, R.E.; Cahoon, D.R. (Louisiana State Univ., Baton Rouge (USA). Center for Wetland Resources). Jan 1988. 414p. NTIS, PC A18/MF A01.

See also Volume 1, PB—88-200803 and Volume 3, PB—88-200829; Also available in set of 3 reports PCE99, PB—88-200795.

In 1985, the Minerals Management Service initiated an investigation to study the causes of wetland loss in the coastal Gulf of Mexico as part of its Outer Continental Shelf environmental-studies program. The purpose of the two-year study was to investigate the factors that contribute to wetland loss and to determine specifically what percentage of the loss is directly and indirectly related to Federal offshore oil and gas development. The primary goal of the Coastal Effects Program is to delineate the onshore impacts of offshore oil and gas development activities. Volume II provides an introduction to the study, direct impacts of OCS activities, saltwater intrusion, subsidence and sedimentation, and landscape patterns and aerial imagery.

41306 **(PB—88-200829/XAB) Causes of wetland loss in the coastal central Gulf of Mexico. Volume 3. Appendices. Final report.** Turner, R.E.; Cahoon, D.R. (Louisiana State Univ., Baton Rouge (USA). Center for Wetland Resources). Jan 1988. 126p. NTIS, PC A07/MF A01.

See also Volume 2, PB—88-200811; Also available in set of 3 reports PC E99, PB—88-200795.

In 1985, the Minerals Management Service initiated an investigation to study the causes of wetland loss in the coastal Gulf of Mexico as part of its Outer Continental Shelf environmental-studies program. The purpose of the two-year study was to investigate the factors that contribute to wetland loss and to determine specifically what percentage of the loss is directly and indirectly related to Federal offshore oil and gas development. The primary goal of the Coastal Effects Program is to delineate the onshore impacts of offshore oil and gas development activities. Volume 3 contains five appendices providing methodological details and data listings.

41307 **(RPC—ENFOR031983) Identification of hydrocarbon emissions from industrial combustion of forest biomass and biomass/oil mixtures. Final report.** Wiesner, C.H. (Research and Productivity Council, New Brunswick (Canada)). Mar 1983. 74p. (CE—01519). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

All types of biomass combustion are known to be major sources of hydrocarbon emissions. Of particular concern from a human health and environmental point of view are those products of incomplete combution known as polycyclic aromatic hydrocarbons (PAH). The objectives of this project were to identify the quantities and chemical structures of hydrocarbons emitted during the industrial combustion of biomass and biomass/oil mixtures, to estimate the health hazard (if any) associated with these hydrocarbon emissions, and to correlate these emissions with burner operating conditions. The first objective has been met. Stack gas samples were taken, under a variety of burner operating conditions, at three different facilities in New Brunswick. Samples were analyzed by gas chromatography and mass spectrometry, identifying and quantifying a series of PAH and saturated hydrocarbons. The last objective has proven difficult. While the most obvious correlation, i.e. increased emission with low excess air is demonstrable by chemical analysis, the influence of minor changes in operating conditions including fuel type and moisture appear to be largely outweighed by natural variations in each system. Consequently, no specific guidelines for operation can be defined other than that optimizing combustion conditions via excess air, turbulent combustion and burner design will minimize hydrocarbon emissions. The combustion of biomass produces hydrocarbon emissions which are qualitatively very similar to those produced by combustion of fossil fuels. The quantitative impact of industrial biomass combustion on air quality is unlikely to be important in comparison to emissions from residential heating systems. 33 refs., 21 figs., 30 tabs.

41308 **Critical chemical reaction rates for multicomponent ground water contamination models.** Jennings, A.A. (Univ. of Toledo, OH (USA)). *Water Resources Research;* 23: No. 9, 1775-1784(Sep 1987). Contract AC02-79EV10253.

A method for determining the validity of the Local Equilibrium Assumption (LEA) for multicomponent contamination models is presented. The LEA may be justified only when interaction rate coefficients are large enough to force solutions of kinetic models to be indistinguishable from their pointwise equilibrium counterparts. When rate constants are not sufficiently large, LEA models can yield large prediction errors. A pulse error method is presented that offers more easily interpreted and less functionally complex measures of LEA error than existing procedures. Pulse error measures are also well conditioned for the questions most often asked of ground water contamination models (arrival times and arrival concentrations at strategic downstream points). Nondimensional results for 1:1 ion exchange are presented to illustrate how pulse error analysis may be used to establish critical Damkohler number constraints for classes of interaction mechanisms. For the example problem discussed the Damkohler number constraint (Da/sub r/ > 100) appears to be more stringent than previously reported.

41309 **Trace element attenuation by Western North Dakota overburden sediments.** Hassett, D.J.; Groenewold, G.H. (Fuels Analysis Lab., Engineering Experiment Station, Univ. of North Dakota, Grand Forks, ND (US)). pp 548-563 of Ninth annual Madison waste conference: Municipal and industrial waste. Madison, WI; University of Wisconsin Computer Sciences Dept. (1987). (CONF-8609245—).

From 9. annual Madison waste conference; Madison, WI, USA (9 Sep 1986).

Trace element attenuation characteristics of typical Western North Dakota overburden sediments were measured with respect to trace elements likely to be leached from low-rank coal ash. The results of this study indicate that overburden sediments in the surface mining areas of western North Dakota have a strong capacity to buffer pH and attenuate arsenic, selenium and cadmium leached from coal combustion wastes. These data are in agreement with observations from ongoing field monitoring studies of fly ash and flue gas desulfurization disposal sites in this same area.

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REFER ALSO TO CITATION(S) 39282, 39325, 39352, 39359, 39413, 39419, 39776, 39787, 39788, 39833, 41140, 41162, 41257, 41258, 41270, 41271, 41272, 41561, 41568

41310 **(ANL—88-13) 1987 annual site environmental report for Argonne National Laboratory.** Golchert, N.W.; Duffy, T.L. (Argonne National Lab., IL (USA)). Apr 1988. Contract W-31109-ENG-38. 111p. NTIS, PC A06/MF A01;1; GPO Dep. Order Number DE88011771/JAW.

The results of the environmental monitoring program at Argonne National Laboratory (ANL) for 1987 are presented and discussed. To evaluate the effect of ANL operations on the environment, sample collections were made on the site, at the site boundary, and off the ANL site for comparison purposes. Measurements were made for a variety of radionuclides in air, surface water, ground water, soil, grass, bottom sediment, and milk. Samples were also analyzed for a variety of chemical constituents in surface water, ground water, and ANL effluent water. Measurements of external penetrating radiation dose were also determined. The potential radiation dose to off-site population groups is estimated. The results of the program are interpreted in terms of the origin of the radioactive and chemical substances (natural, fallout, ANL, and other) and are compared with applicable environmental quality standards. A United States Department of Energy (DOE) dose calculation methodology, based on recent International Commission on Radiological Protection (ICRP) recommendations, is used in this report. The average concentrations and total amounts of radioactive and chemical pollutants released by ANL to the environment were all below appropriate standards. 29 refs., 8 figs., 42 tabs.

41311 **(DOE/ID—12111) Summaries of the Idaho National Engineering Laboratory Radioecology and Ecology Program research projects.** Markham, O.D. (comp.). (USDOE Idaho Operations Office, Idaho Falls. Radiological and Environmental Sciences Lab.). Jun 1987. Contract AC07-76ID01570. 48p. NTIS, PC A03/MF A01; GPO Dep. Order Number DE88008582/JAW.

This report provides summaries of individual research projects conducted by the Idaho National Engineering Laboratory Radioecology and Ecology Program. Summaries include projects in various stages, from those that are just beginning, to projects that are in the final publication stage.

41312 **(DOE-RW—88.029) Radionuclide concentrations in bird tissues, their foods and feeding areas near Ravenglass.** Lowe, V.P.W. (Department of the Environment, London (UK); Merlewood Research Station, Grange-over-Sands (UK). Inst. of Terrestrial Ecology). Aug 1987. 43p. (ITE—880). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88753986/JAW.

Since 1983, concern has been expressed about an apparent decline in the numbers of waterfowl, waders and gulls in the Ravenglass estuary, particularly of the black-headed gulls nesting on the Drigg dunes; it was suggested this might be due to the radionuclide concentrations in their diet and general environment. Oystercatchers and shelduck had some of the highest concentrations of Cs-137 in their tissues, yet their breeding and numbers remained unaffected. Calculations of the total dose equivalent to the whole body of gulls spending 4 months in the estuary before laying eggs, amounted to 2.8 mSv (≃ 2.4 m Gy), and to the gut lining 40.3 mSv. As a minimum chronic dose of 1000 m Gy d/sup -1/ has been found to be necessary to retard the growth of chicks or cause 50% mortality among gull chick embryos before full development, radionuclide concentrations at Ravenglass were at least three orders of magnitude too low to have any effect. 12 species of marine invertebrates were also analysed, but no evidence was found that radionuclides from Sellafield were being accumulated in any species to the point where concentrations were of potential importance to birds feeding on them.

41313 **(GKSS—87/E/58) Strontium-90 in environmental samples from Northern Germany before and after the Chernobyl accident.** Wilken, R.D.; Diehl, R. (GKSS-Forschungszentrum Geesthacht G.m.b.H., Geesthacht-Tesperhude (Germany, F.R.)). 1987. 7p. Reprint from Radiochim. Acta (1987) v. 41(4) p. 157-162.

The analytical procedure for determining in environmental samples is presented and alternative methods are discussed. The HNO/sub 3/-method seems to be the best method because it is well proven, has a satisfactory limit of detection and can be used for different kinds of environmental samples. In soil, grass and milk the Sr-90 concentrations are given for samples taken from January 1985 to April 1986 and those taken from May to September 1986. In soil, no increase of Sr-90 due to Chernobyl fallout was observed. In grass, an increase by a factor of about 3 was observed in the first month after the Chernobyl accident, probably from a surface contamination. In milk, there was an increase by a factor of about 2 in the first month. Compared to values obtained since 1961, the absolute concentration of Sr-90 in milk was by a factor of 10 higher in 1963, and it was higher for over 20 years than the average after the Chernobyl accident. Compared to Sr-90, the Sr-89 content was higher by a factor of 5. The ratio Cs-137/Sr-90 was approximately 35:1 compared to a ratio of 5:1 in 1963. (orig./HP)

41314 **(IC—87/409) On the general procedure for modelling complex ecological systems.** He Shanyu. (International Centre for Theoretical Physics, Trieste (Italy)). Dec 1987. 10p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88703011/JAW.

In this paper, the principle of a general procedure for modelling complex ecological systems, i.e. the Adaptive Superposition Procedure (ASP) is shortly stated. The result of application of ASP in a national project for ecological regionalization is also described. (author). 3 refs.

41315 **(IC—87/413) Basic theory of desertification.** Njau, E.C. (International Centre for Theoretical Physics, Trieste (Italy)). Dec 1987. 18p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703014/JAW.

A new theory is developed for explaining the processes that give rise to desertification. This theory is arrived at through analyses of possible influences of Earth's surface albedo modifications upon the general atmospheric circulation patterns with the aid of a recent theory of Sun-Climate/Weather links (Njau, 1985a; 1985b; 1986; 1987a; 1987b). It is shown that surface-albedo modification in a given region will not induce significant changes in the general atmospheric circulation patterns unless the region's size is at least equal to a certain minimum value. Finally, a new desertification indicator is suggested. (author). 27 refs, 3 figs.

41316 **(JAERI-M—88-074) Three dimensional computer code for prediction of radionuclides migration in a porous medium (MIGSTEM-3D).** Ohnuki, Toshihiko. (Japan Atomic Energy Research Inst., Tokyo). Mar 1988. 30p. (In Japanese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88754134/JAW.

A three dimensional prediction code for radionuclides migration (MIGSTEM-3D) has been developed to estimate the migration of radionuclides through shallow land soil. The MIGSTEM-3D is a differential model for determination of the both migration in unsaturated and saturated soil layers. Three types of liquid-solid adsorption reaction model, such as linear isotherm, first order irreversible kinetic and first order reversible kinetic models, are considered in the MIGSTEM-3D. The incorporate model was also applied to estimate the migration of the radionuclides which consisted of several migration fractions controlled by different migration mechanisms. The validity of MIGSTEM-3D was confirmed by comparing the concentration calculated by MIGSTEM-3D with that by analytical solution. The migration of a radionuclide through shallow land soil was estimated at two different assumed sites.

41317 **(PNL—6415) Hanford Site National Environmental Policy Act (NEPA) characterization.** Cushing, C.E. (ed.). (Pacific Northwest Lab., Richland, WA (USA)). Dec 1987. Contract AC06-76RL01830. 221p. NTIS, PC A10/MF A01;1; GPO Dep. Order Number DE88011211/JAW.

In this document, a complete description of the environment is presented in Section 4 without extensive tabular data. For these data, sources are provided. Most subjects are divided into a general description of the characteristics of the Hanford Site, followed by site-specific information where it is available on the 100, 200, and 300 Areas. This division will allow a person requiring information to go immediately to those sections of particular interest. However, site-specific information on each of these separate areas is not always complete or available. In this case, the general Hanford Site description should be used. Certain subjects covered (e.g., threatened and endangered species, Tri-Cities populations) will be updated periodically and changes published annually. The updating also applies to the basic data when new information becomes available. To this end, Section 4 of this document is being made available in loose-leaf text and on an IBM-PC diskette in WordPerfect 4.2. 130 refs., 14 figs., 30 tabs.

41318 **(SSI—87-32) BIOMOVS: An international model validation study.** Haegg, C.; Johansson, G. (National Inst. of Radiation Protection, Stockholm (Sweden)). 16 Nov 1987. 10p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88754036/JAW.

BIOMOVS (BIOspheric MOdel Validation Study) is an international study where models used for describing the distribution of radioactive and nonradioactive trace substances in terrestrial and aquatic environments are compared and tested. The main objectives of the study are to compare and test the accuracy of predictions between such models, explain differences in these predictions, recommend priorities for future research concerning the improvement of the accuracy of model predictions and act as a forum for the exchange of ideas, experience and information.

41319 (STUK-A—54, pp 91-106) **Soil and terrestrial indicators. Chapter 5.** Mar 1987. NTIS (US Sales Only), PC A09/MF A01. Order Number DE88780083/JAW.

In Studies on environmental radioactivity in Finland 1984-1985. Annual report.

Long-lived radionuclides ^{90}Sr, ^{137}Cs and ^{239}, ^{240}Pu in soil are analysed in the vicinity of nuclear power stations every four years. Both vertical disribution and the total amount of radionuclides per unit of area are determined from the samples. The results of surveys carried out at Loviisa in 1983 and at Olkiluoto in 1984 are presented here. The total deposition determined by soil samples had decreased slightly since the previous soil studies and was, on average, 630 Bq m^{-2} of ^{90}Sr, 1800 Bq m^{-2} ^{137}Cs and 30 Bq m^{-2} ^{239}, ^{240}Pu. To follow up short-lived radionuclides in deposition, an indicator organism, hair moss, is analysed four times a year in the vicinity of nuclear power stations. Hair moss principally reflects the fall-out from nuclear weapon tests. Small amounts of ^{60}Co released from power stations was also detectable. Both an indicator and a step in the food chain leading to man, pasture grass was analysed in the vicinity of nuclear power stations twice during the growing season. The concentrations of ^{137}Cs were very low, and no ^{131}I was detected. The results for hair moss and pasture grass at Loviisa from 1980-1985 and from 1981-1985 at Olkiluoto are given.

41320 **(STUK-A—62) Radioactivity of game meat in Finland after the Chernobyl accident in 1986. Supplement 7 to Annual Report STUK-A55.** Rantavaara, A.; Hyvoenen, T.; Nygren, T.; Nygren, K. (Finnish Centre for Radiation and Nuclear Safety, Helsinki). Jun 1987. 62p. NTIS (US Sales Only), PC A04/MF A01. Order Number DE88754090/JAW.

Radioactive substances in game meat were studied in summer and early autumn 1986 by the Finnish Centre for Radiation and Nuclear Safety in cooperation with the Finnish Game and Fisheries Research Institute. The concentrations of radioactive cesium and other gamma-emitting nuclides were determined on meat of moose and other cervids and also on small game in various parts of the country before or in the beginning of the hunting season. The most important radionuclides found in the samples were ^{134}Cs and ^{137}Cs. In addition to these, ^{131}I was detected in the first moose meat samples in the spring. None of them was significant as far as the dietary intake of radionuclides is concerned. The transfer of fallout radiocesium to game meat was most efficient in the case of the arctic hare and inland waterfowl; terrestrial game

birds and the brown hare belonged to the same category as moose. In 1986 the mean dietary intake via game meat was for ^{131}Cs 47 Bq per person and for ^{137}Cs 106 Bq per person. In 1987 the corresponding values were 69 Bq per person for ^{134}Cs and 180 Bq per person for ^{137}Cs. The contribution of cervids to the total dietary intake of radiocesium via game meat was 3/4, which was slightly less than their contribution to the annual game bag. On the basis of the preliminary results of this study it was concluded in autumn 1986 that there was no need to restrict hunting in the year 1986/1987. The radiocesium found in the meat of terrestrial game animals did not necessitate any recommendations on their use. As regards the meat of waterfowl caught in the main inland fallout area, it was recommended not to eat more than 20 kg per person.

41321 **(STUK-B-VALO—51) Influence of the Chernobyl accident on radioactivity of fuel peat and peat ash in Finland.** Mustonen, R.; Salonen, S.; Jantunen, M.; Reponen, A.; Itkonen, A. (Finnish Centre for Radiation and Nuclear Safety, Helsinki). Apr 1988. 36p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88754092/JAW.

The accident at the Chernobyl nuclear power plant in April 1986 caused very uneven deposition of radionuclides in Finland. The deposited radionuclides were measured in relative high concentrations in fuel peat and especially in peat ash. The radionuclide concentrations were measured at six peat-fired power plants in different parts of Finland throughout the heating season 1986-1987. Also evaporation of different radionuclides in peat combustion and their condensation on fly ash particles were studied at four power plants. The ^{137}Cs-concentrations in compiled peat samples varied between 30 and 3600 Bq kg^{-1} dry weight and in ash samples between 600 and 68000 Bq kg^{-1}. Differences in radionuclide concentrations between the power plants were great and also the radionuclide composition in fuel peat varied regionally. The ^{137}Cs-concentrations of the fly ash after the ash precipitators varied between 12000 and 120000 Bq kg^{-1} and fly ash emissions varied from 17 to 1100 mg m^{-3}, depending on the power plant and the load of the boiler. High radioactivity concentrations in precipitator ash caused some restrictions to the utilization of peat ash for various purposes.

41322 **(UCID—21390) Report of workshop on radiological effects of nuclear war, SCOPE-ENUWAR workshop, Moscow, USSR, March 21-25, 1988.** Shapiro, C.S. (Lawrence Livermore National Lab., CA (USA)). Mar 1988. Contract W-7405-ENG-48. 12p. (CONF-880367—Summ.). NTIS, PC A03/MF A01; GPO Dep. Order Number DE88009864/JAW.

From SCOPE-ENUWAR workshop on the environmental consequences of nuclear war; Moscow, USSR (20 Mar 1988).

The workshop on radiological consequences of nuclear war addressed specific issues that built on the foundation of the results that were published in the SCOPE-ENUWAR report (SCOPE-28) in 1986. 14 refs.

41323 **Comprehensive environmental assessment and response program confirmation and evaluation activities.** Martz, M.K.; Rea, K.H.; Vocke, R.W.; Ferenbaugh, R.W. (Los Alamos National Lab., Los Alamos, NM (US)). pp 1-3 of Management of uncontrolled hazardous waste sites. Silver Spring, MD; Hazardous Materials Control Research Institute (1986). (CONF-861227—).

From Superfund '86: 7th national conference on management of uncontrolled hazardous waste sites; Washington, DC, USA (1 Dec 1986).

The U.S. Department of Energy Albuquerque Operations Office (U.S. DOE-AL) initiated the Comprehensive Environmental Assessment and Response Program (CEARP) to identify, evaluate and conduct remedial actions at hazardous waste disposal and contamination sites on the eight nuclear weapons development and production installations under its jurisdiction. The CEARP is being implemented in five phases: Phase 1 - Installation Assessment; Phase 2 - Confirmation; Phase 3 - Technological Assessment; Phase 4 - Remedial Action, and Phase 5 - Compliance and Verifiction. During Phase 1, regulatory compliance was evaluated and disposal/contamination sites were identified. Phase 2 will provide the field data for site characterization, risk assessment, determination of need for corrective action and evaluation of possible remedial actions at hazardous waste sites. Phase 2 is being conducted in two stages: (1) monitoring plan development/reconaissance sampling and (2) site characterization/remedial investigation. Problem sites across the U.S. DOE-AL complex were prioritized for site characterization and CEARP Phase 2 activities have been initiated.

5104 Thermal Effluents Monitoring And Transport

REFER ALSO TO CITATION(S) 41317

5105 Site Resource And Use Studies

REFER ALSO TO CITATION(S) 39177, 39324, 39334, 39411, 39412, 39413, 39414, 39415, 39477, 39614, 40067, 41323

41324 (CONF-871075—Vol.1-Pt.1, pp 333-343) **Integrating waste management into the curriculum.** Greene, L.R.; Dunbar, C.A. (Roane State Community College, Harriman, TN (USA)). Oct 1987. NTIS, PC A15/MF A01. Order Number DE88007803/JAW.

From 3. Oak Ridge model conference on waste problems; Oak Ridge, TN, USA (13 Oct 1987).

In response to requests of area firms involved in Waste Management/Waste Cleanup processes, Roane State Community College has developed and submitted for State Board of Regents approval pertinent associate degree program options. Assuming approval by this body, the proposals will then be submitted to the Tennessee Higher Education Commission for consideration at their October meeting. The proposals include an associate degree program in Environmental Health Technology and a program option in Land Reclamation under the current Mining Technology program. The Environmental Health Technology program contains three options: the existing Health Physics option and new options - Industrial Hygiene and Waste Management. Fall 1988 is the targeted start-up date. Problems inherent in the start-up efforts include lag time in state funding procedures, lack of appropriate library resources and laboratory equipment, and the need for qualified faculty. Roane State is also developing non-credit training programs which meet the OSHA training requirements for workers engaged in hazardous waste activities.

41325 **(DOE/EA—0215) Proposed Microwave Transmission Facility, Malta, Phillips County, Montana: Environmental assessment.** (Department of Energy, Billings, MT (USA). Western Area Power Administration). Apr 1983. 8p. NTIS, PC A02/MF A01;1; GPO Dep. Order Number DE88008320/JAW.

Western proposes to construct a microwave communications facility at the Malta site consisting of a 175 foot to 200 foot tall, guyed, lattice-type steel tower, a building approximately 10' x 16' x 8' in size to house electrical and electronic equipment, an approximately 400 square feet graveled parking area for motor vehicles, and a graveled access road about 300 feet in length and about 20 feet ot 30 feet wide. 1 fig.

41326 **(DOE/EA—0216) Proposed Microwave Communications Facility, Rapid City, Pennington County, South Dakota: Environmental assessment.** (Department of Energy, Billings, MT (USA). Western Area Power Administration). Apr 1983. 33p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88008319/JAW.

The proposed project would involve the acquisition of an easement for the use of a parcel of land about 2.07 acres in size, on top of a hill north of Rapid City, North Dakota, in the W-1/2, SE-1/4, NE-1/4, SW-1/4 of Section 23, T2N, R7E of the Black Hills Meridian. Access to the site would be via existing gravel roads and vehicle trails. A self-supporting tower about 40 to 100 feet tall would be erected on the site, and building about 10' x 16' x 8' would be constructed to house electrical and electronic equipment. The tower and building area would be surrounded by a chain link security fence, enclosing an area of about 3000 to 4000 square feet. Permanent ground disturbance would occur only for construction of a concrete pad for the building, the tower foundation and setting fence posts. The maximum area required for the tower foundation

would be about 1670 square feet assuming a 100' tall tower with a four-legged self-supporting configuration. 27 refs., 6 figs.

41327 **(DOE/EA—0280) Silver Creek-Morton Transmission Project: Environmental assessment.** (Department of Energy, Washington, DC (USA). Div. of Electric Energy Systems). Jun 1986. 34p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88008276/JAW.

Bonneville Power Administration (BPA) will in 1989, replace the Silver Creek-Morton 69-kV transmission line with a line of 115-kV construction and, in the late 1990's, add capacitors at Morton Substation. Portions of the new line would be constructed on new right-of-way adjacent to the old 69-kV line and portions would be constructed on the same right-of-way. Construction on adjacent right-of-way would require new right-of-way up to 50 feet wide on one side of the present right-of-way. BPA would then release to private ownership right-of-way up to 50 feet wide on the opposite side, after the old line has been removed. Parts of the new line would be constructed on H-frame wood-pole sructures and parts on single wood-pole structures, depending on land use constraints. 16 refs., 3 figs., 3 tabs.

41328 **(DOE/EA—0284) Casper to Dave Johnston 230-kV Transmission Line Project: Environmental assessment.** (USDOE Western Area Power Administration, Washington, DC). 1986. 113p. NTIS, PC A06;3. Order Number DE88008269/JAW.

Western proposes to reconstruct the existing Casper-Glendo North 115-kV Transmission Line to 230-kV between a point 1.1 miles northeast of the Pacific Power and Light (Pacific) Casper Substation and the Dave Johnston (DJ) Powerplant near Glenrock, Wyoming. As part of the proposed action, Western proposes to remove the portion of the existing Casper-Glendo South 115-kV Transmission Line between Western's Casper Substation and the intersection with the Casper-Glendo North Transmission Line, about 15 miles east of Casper. The removed portion of the Casper-Glendo North Transmission Line would be rebuilt on steel, single-shaft, structures. The section between the point northeast of the Pacific Substation and the intersection with the Casper-Glendo South Transmission Line would be double circuit (230-kV/115-kV). At the intersection of the north and south lines, the new 115-kV section would be tied to the remaining portion of the Casper-Glendo South Line to complete the 115-kV Casper-Glendo circuit. 52 refs.,12 figs., 14 tabs.

41329 **(DP-MS—88-87) Remote sensing of wetlands: Applications overview.** Mackey, H.E. Jr.; Jensen, J.R. (Savannah River Lab., Aiken, SC (USA); South Carolina Univ., Columbia (USA). Dept. of Geography). 1988. Contract AC09-76SR00001. 3p. (CONF-8805118—1). NTIS, PC A02/MF A01;1; GPO Dep. Order Number DE88010895/JAW.

From 1. special workshop on videography; Terre Haute, IN, USA (19 May 1988).

Wetlands, unlike many upland plant community types, present various challenges to effective evaluation and quantification. Wetlands cover a wide range from small tributary streams to shrub/scrub and marsh communities to open water lacustrine environment. Thus, the heterogeneity of species composition and spacial distribution of wetlands can present a formidable challenge for evalaution with remote sensing techniques. In addition, wetlands can change dramatically seasonally, especially with the development of non-persistent species. Various types of remote sensing data have been used to map and characterize wetlands. Regionally Landsat MSS and TM satellite data have been used for wetland mapping by various government agencies and private organizations, such as Ducks Unlimited. In addition, multispectral SPOT data are becoming available and provide opportunities for increased spatial resolution and frequency of coverage. 11 refs.

41330 **(SREL—23) Wood Storks of the Birdsville Colony and swamps of the Savannah River Plant: 1985 annual report.** Coulter, M.C. (Savannah River Ecology Lab., Aiken, SC (USA)). May 1986. Contract AC09-76SR00819. 138p. NTIS, PC A07/MF A01;1; GPO Dep. Order Number DE88010876/JAW.

Our objectives in 1985 were to determine the location of foraging sites of Wood Storks from their Birdsville colony; to characterize the habitat, vegetation, water quality and prey density/biomass at these sites; to examine seasonal changes in prey density at foraging sites and to relate this to the stork use of the foraging sites; to observe the breeding birds to determine times when food demands at the colony are greatest; to determine the breeding success of the storks at the Birdsville rookery; to examine the movement of storks from the rookery to foraging sites; to continue to evaluate the importance of the SRSS to foraging Wood Storks; to examine the movements of individual birds to determine the generality of the observed patterns; and to compare the 1985 patterns with those observed in previous years.

41331 **Fate of an artificial pond receiving drainage from a reclaimed coal refuse and slurry area.** Vinikour, W.S.; LaGory, K.E.; Pentecost, E.D. (Argonne National Lab., IL (USA)). pp 167-172 of Mine drainage and surface mine reclamation. Volume II. Mine reclamation, abandoned mine lands and policy issues. Washington, DC; Department of the Interior (1988). (CONF-880413—). Contract W-31-109-ENG-38.

From Annual meeting of the American Society for Surface Mining and Reclamation; Pittsburgh, PA, USA (17 Apr 1988).

A pond was created as part of a reclamation effort at an abandoned coal mine near Staunton, IL. The pond was designed to help control runoff and to provide wildlife habitat. The benthic macroinvertebrates were analyzed as part of the site reclamation evaluation. Macroinvertebrates were collected from the newly created pond, a retention pond that received gob pile drainage, and a farm pond that served as a control. Reclamation activities began in 1976; samples were collected from the ponds in 1977, 1978, and 1987. Results from 1977 and 1978 indicated that the newly created pond was developing into a productive ecosystem. During those years, the benthos was dominated by dipterans, especially chironomids. By 1987 the pH of the new pond had declined to below 2.5 and no invertebrates were found in the new pond or the retention pond. Phytoplankton was found in the new pond, but species richness and abundance were severely limited. Efforts to create viable aquatic habitats in slurry areas of abandoned coal mine sites may be subject to failure unless remedial actions, such as neutralization, are conducted on a regular basis.

41332 **Reclamation success at an abandoned deep coal mine site near Staunton, Illinois.** LaGory, K.E.; Pentecost, E.D.; Vinikour, W.S. (Argonne National Lab., IL (USA)). pp 221-227 of Mine drainage and surface mine reclamation. Volume II. Mine reclamation, abandoned mine lands and policy issues. Washington, DC; Department of the Interior (1988). (CONF-880413—). Contract W-31-109-ENG-38.

From Annual meeting of the American Society for Surface Mining and Reclamation; Pittsburgh, PA, USA (17 Apr 1988).

Reclamation activities began in 1976 on the 13.8-ha site of an abandoned deep coal mine near Staunton, IL. An area of about 9.3 ha was severely eroded, devoid of vegetation, and received little use by wildlife. Reclamation procedures included grading and recontouring the coal refuse (gob) pile and slurry area, covering exposed refuse material with soil, liming the soil, seeding with selected plant species, and creating a pond to receive runoff from the site. To evaluate reclamation, soil depth (30 and 60 cm) and liming rate (112 and 224 t $CaCO_3$ equivalent/ha) were experimentally manipulated in plots on top of the gob pile. Studies were conducted annually from 1977 to 1982 and again in 1987. After reclamation activities were completed, vegetation quickly became established over most of the site, except for some areas on the slopes of the gob pile. Vegetative cover was greatest on plots with 60 cm of soil and a 224 t/ha liming rate. Soil depth appeared to be more importance than liming rate in determining vegetative cover. Wildlife used the site following reclamation, especially those areas with the greatest habitat diversity.

41333 **Instrumentation for continuous monitoring of meteorological variables and soil gas pressures in landfill cover.** Moore, C.; Vogt, M.; Bogner, J. (Geotechnics, Inc., Columbus, OH (US)). pp 1-8 of Ninth annual Madison waste conference: Municipal and industrial waste. Madison, WI; University of Wisconsin Computer Sciences Dept. (1987). (CONF-8609245—).

From 9. annual Madison waste conference; Madison, WI, USA (9 Sep 1986).

To examine changes in soil gas pressure relative to changes in atmospheric pressure and other meteoreological variables, weather station sensors and electronic pressure transducers were interfaced with an RCA COSMAC microcomputer. The microcomputer control permitted simultaneous acquisition of pressure and meteorological data on cassette tape. Because the RCA unit uses CMOS circuitry, it and be battery operated, and is therefore well suited for collecting data at remote locations on landfills. A tape I/O board, an A/D converter board and two custom boards were required additions to the basic CDP18S601 board for this application. Meterological data, including wind speed, wind direction, air temperature, precipitation, and solar radiation, were monitored using a Climatronics EWS system. Barometric pressure and soil gas pressures on subsurface probes were monitored using electronic pressure transducers with a 10-20 psia range. Cassette tape output was dumped directly to WYLBUR files on the Argonne National Laboratory (ANL) IBM 3033 mainframe for subsequent data analysis.

41334 **Gas movement through fractured landfill cover materials.** Bogner, J.E.; Moore, C.A. (Argonne National Lab., Argonne, IL (US)). pp 288-309 of Ninth annual Madison waste conference: Municipal and industrial waste. Madison, WI; University of Wisconsin Computer Sciences Dept. (1987). (CONF-8609245—).

From 9. annual Madison waste conference; Madison, WI, USA (9 Sep 1986).

Bidirectional gas movement through fractured landfill cover materials is being studied at the Mallard North Landifll in DuPage County, Illinois. Vertical pressure and concentration gradients were monitored during changing meteorological and soil moisture conditions. Nests of probes for direct observation of subsurface soil gas pressures were installed in the top of the refuse and at depths of 1.2m and 0.6m. Subsurface gas pressures, barometric pressure, wind speed, wind direction, solar radiation, air temperature, and precipitation were continuously monitored. A field gas chromatograph permitted frequent analysis of methane, carbon dioxide, nitrogen, and oxygen in soil gas samples from the various probes. Tensiometers provided information on soil moisture conditions. During dry weather, soil gas pressures at all depths equilibrated rapidly with barometric pressure and exhibited diurnal variations that were inversely proportional to diurnal temperature variations. When cover materials became saturated, changes in soil gas pressures sometimes lagged behind changes in atmospheric pressure by two to three hours. Soil gas concentrations generally exhibited relatively small short-term variations, but responded over the longer term to changing soil moisture conditions. Carbondioxide:methane ratios suggest that an important near-surface process is the activity of methane-oxidizing bacterial, which consume methane that might otherwise be available to a gas recovery system.

5106 Regulations

REFER ALSO TO CITATION(S) 39432, 41378, 41379, 41380, 41381, 41382, 41383, 41384, 41385, 41386, 41387, 41392, 41393, 41395

41335 **(AD-A—191020/7/XAB) Installation Restoration Program Phase 1. Records search. Air Force Plant Number 36, Ohio. Final report.** (Engineering-Science, Inc., Atlanta, GA (USA)). Jul 1985. 132p. NTIS, PC A07/MF A01.

See also AD-A191 021.

This report provides the Installation-Restoration Program (IRP) Phase I-Records Search for Air Force Plant 36, Evendale, Ohio. This is a report of a study conducted to identify past potentially hazardous-material disposal sites. Interviews and document searches were conducted to determine sites that were potentially contaminated.

52 ENVIRONMENTAL SCIENCES, AQUATIC

REFER ALSO TO CITATION(S) 40009

5201 Basic Studies

REFER ALSO TO CITATION(S) 39183, 41351, 41632

41336 **(BR—82(10.151)) Habitat suitability index models: Diamondback terrapin(nesting): Atlantic Coast.** Palmer, W.M.; Cordes, C.L. (North Carolina Museum of Natural History, Raleigh (USA); Fish and Wildlife Service, Slidell, LA (USA). National Wetlands Research Center). Mar 1988. 18p. US Fish and Wildlife Service, 1010 Gause Boulevard, Slidell, LA 70458;1. Order Number TI88900628/JAW.

A review and synthesis of existing information were used to develop a Habitat Suitability Index (HSI) model for the diamondback terrapin (Malaclemys terrapin). The model is scaled to produce an index between 0.0 (unsuitable habitat) and 1.0 (optimum habitat). HSI models are designed to be used with Habitat Evaluation Procedures previously developed by the US Fish and Wildlife Service.

41337 **(BR—85(7.3)) The St. Clair River and Lake St. Clair, Michigan: An ecological profile.** Edsall, T.A.; Manny, B.A.; Raphael, C.N. (National Fisheries Research Center-Great Lakes, Ann Arbor, MI (USA); Eastern Michigan Univ., Ypsilanti (USA). Dept. of Geography and Geology). Apr 1988. 130p. U.S. Fish and Wildlife Services, NASA-Slidell Computer Complex, 1010 Gause Boulevard, Slidell, LA 70458. Order Number TI88012556/JAW.

The St. Clair and Lake St. Clair form a part of the connecting channel system between Lake Huron and Lake Erie. This report synthesizes existing information on the ecological structure and function of this ecosystem. Chapters include descriptions of climatology, hydrology, and geology of the region; biological characteristics; ecological relationships; and commercial and recreations uses, as well as discussions of management considerations and issues. The St. Clair system provides valuable habitat for migratory waterflow and fish spawning and nurseries, and contains some of the most extensive emergent wetlands in the region. The system is used for navigation, municipal and industrial waste disposal, recreational boating, fishing and waterfowl hunting. Allowing for multiple human uses while maintaining important waterfowl and fish populations is the greatest challenge facing managers of this system. 220 refs., 75 figs., 40 tabs.

41338 **(DP-MS—88-73) Macrophyte mapping with video technology in a fresh water lake.** Mackey, H.E. Jr.; Jensen, J.R. (Savannah River Lab., Aiken, SC (USA); South Carolina Univ., Columbia (USA). Dept. of Geography). 1988. Contract AC09-76SR00001. 6p. (CONF-8805118—2). NTIS, PC A02/MF A01;1; GPO Dep. Order Number DE88011207/JAW.

From 1. special workshop on videography; Terre Haute, IN, USA (19 May 1988).

False color infrared video data from a small cove of a large freshwater lake were digitized and processed to evaluate the use of these data for macrophyte mapping. Estimates obtained for widths and areas with the video data were comparable to those from scaled aerial photography. 9 refs., 2 figs., 2 tabs.

41339 **(PB—88-178462/XAB) Selected marine mammals of Alaska: species accounts with research and management recommendations.** Lentfer, J.W. (Marine Mammal Commission, Washington, DC (USA)). 1988. 280p. NTIS, PC A13/MF A01.

This book is the result of a need seen by the Marine Mammal Commission for a current summary of the biology and status of ten species of Alaskan marine mammals, including recommendations for research and management. Its purpose is to serve as

a reference and working document as conservation and management plans are developed and implemented for the ten species.

41340 **(PB—88-196514/XAB) Study of biological processes on the US North Atlantic slope and rise. Volume 2. Final report. Report for November 1984-November 1986.** Maciolek, N.; Grassle, J.F.; Hecker, B.; Brown, B.; Blake, J.A. (Battelle Ocean Sciences, Duxbury, MA (USA)). 15 Dec 1987. 538p. NTIS, PC A23/MF A01.

See also PB—88-196522.

Temporal and spatial variations in infaunal community structure, sediment texture, and concentrations of total organic carbon, hydrogen, nitrogen, and hydrocarbons in sediments were sampled at 14 stations six times between November 1984 and July 1986. Megafaunal populations were studied along a transect near the U.S./Canadian boundary, a second transect to the west, and along the 2100-m isobath near Lydonia Canyon. The fauna appears to change along depth gradients. These stations are dominated by large-bodied infaunal sipunculans and aplacophoran molluscs. Metazoan epifauna is sparse on the mid-slope of the western transect, but the densities of giant protozoans peak at these depths. Recolonization experiments indicate slow rates of recovery of disturbed environments.

41341 **(PB—88-196522/XAB) Study of biological processes on the US North Atlantic slope and rise. Volume 1. Executive summary. Report for November 1984-November 1986.** Maciolek, N.; Grassle, J.F.; Hecker, B.; Brown, B.; Blake, J.A. (Battelle Ocean Sciences, Duxbury, MA (USA)). 15 Dec 1987. 52p. NTIS, PC A04/MF A01.

See also PB—88-196514.

Temporal and spatial variations in infaunal community structure, sediment texture, and concentrations of total organic carbon, hydrogen, nitrogen, and hydrocarbons in sediments were sampled at 14 stations six times between November 1984 and July 1986. Megafaunal populations were studied along a transect near the U.S./Canadian boundary, a second transect to the west, and along the 2100-m isobath near Lydonia Canyon. The fauna appears to change along depth gradients. The most distinct communities were seen on the upper slope, where sediments are coarse and currents presumably are strong. Recolonization experiments indicate slow rates of recovery of disturbed environments.

41342 **(PB—88-199732/XAB) Alaskan marine mammal tissue archival project: a project description including collection protocols.** Becker, P.R.; Wise, S.A.; Koster, B.J.; Zeisler, R. (National Bureau of Standards, Washington, DC (USA). Center for Analytical Chemistry). Mar 1988. 54p. (NBSIR—88/3750). NTIS, PC A04/MF A01.

The Alaskan Marine Mammal Tissue Archival Project was initiated in 1987. Although the emphasis is on the collection of tissues for analysis of contaminants that may be associated with the petroleum industry, the development of an archive of marine mammal tissues collected and stored using carefully controlled procedures provides an important resource addressing questions concerning the transport of elements and compounds (contaminants and non-contaminants) throughout the polar ecosystem. The document provides the basic information on Project objectives and management, justification for the species, tissues, and contaminants of interest, and specific instructions for collecting, handling, and storing samples.

41343 **(PB—88-205729/XAB) Southwest Florida Shelf benthic communities study. Year 5 annual report.** (Environmental Science and Engineering, Inc., Gainesville, FL (USA)). 1986. 1150p. NTIS, PC E99.

Set includes PB—88-205737 through PB—88-205752. See also PB—86-246303.

A separate abstract is included for each of the three reports of this set.

41344 **(PB—88-205737/XAB) Southwest Florida Shelf benthic communities study. Year 5 annual report. Volume 1. Executive summary.** Danek, L.J.; Lewbel, G.S. (Environmental Science and Engineering, Inc., Gainesville, FL (USA)). Sep 1986. 55p. NTIS, PC A04/MF A01.

See also Volume 2, PB—88-205745 and PB—86-246311; Also available in set of 3 reports PC E99, PB—88-205729.

In 1980, the Minerals Management Service initiated a multiyear program to study the biogeochemical character and seasonal community patterns occurring in the region. The particular program, the Southwest Florida Shelf Ecosystems Program, has three primary goals: (1) to determine the potential impact of outer continental shelf (OCS) oil and gas offshore activities on live-bottom habitats and communities, which are integral components of the southwest Florida shelf ecosystem; (2) to produce habitat maps that show the location and distribution of various bottom substrates; and (3) to broadly classify the biological zonation across and along the shelf projecting the percent of the area covered by live/reef bottoms and the amount covered by each type of live/reef bottom. Volume I provides an introduction of the study and describes the physical characterization, biological characterizations, and recommendation for further work.

41345 **(PB—88-205745/XAB) Southwest Florida Shelf benthic communities study. Year 5 annual report. Volume 2. Technical discussion.** Danet, L.J.; Lewbel, G.S. (Environmental Science and Engineering, Inc., Gainesville, FL (USA)). Sep 1986. 582p. NTIS, PC A25/MF A01.

See also Volume 1, PB—88-205737 and Volume 3, PB—88-205752 and PB—86-246329; Also available in set of 3 reports PC E99, PB—88-205729.

In 1980, the Minerals Management Service initiated a multiyear program to study the biogeochemical character and seasonal community patterns occurring in the region. The particular program, the Southwest Florida Shelf Ecosystems Program, has three primary goals: (1) to determine the potential impact of outer continental shelf (OCS) oil and gas offshore activities on live-bottom habitats and communities, which are integral components of the southwest Florida shelf ecosystem; (2) to produce habitat maps that show the location and distribution of various bottom substrates; and (3) to broadly classify the biological zonation across and along the shelf projecting the percent of the area covered by live/reef bottoms and the amount covered by each type of live/reef bottom. Volume II is the technical discussion for the study.

41346 **(PB—88-205752/XAB) Southwest Florida Shelf benthic communities study. Year 5 annual report. Volume 3. Appendices.** Danek, L.J.; Lewbel, G.S. (Environmental Science and Engineering, Inc., Gainesville, FL (USA)). Sep 1986. 513p. NTIS, PC A22/MF A01.

See also Volume 2, PB—88-205745 and PB—86-246337; Also available in set of 3 reports PC E99, PB—88-205729.

In 1980, the Minerals Management Service initiated a multiyear program to study the biogeochemical character and seasonal community patterns occurring in the region. The particular program, the Southwest Florida Shelf Ecosystems Program, has three primary goals: (1) to determine the potential impact of outer continental shelf (OCS) oil and gas offshore activities on live-bottom habitats and communities, which are integral components of the southwest Florida shelf ecosystem; (2) to produce habitat maps that show the location and distribution of various bottom substrates; and (3) to broadly classify the biological zonation across and along the shelf projecting the percent of the area covered by live/reefs bottoms and the amount covered by each type of live/reef bottom. Volume III contains these appendices providing methodological details and data listings.

41347 **(UCRL—98628) Turn-ons and turn-offs: Causes and mechanisms of the initiation and termination of coral reef growth.** Buddemeier, R.W.; Hopley, D. (Lawrence Livermore National Lab., CA (USA)). 26 Apr 1988. Contract W-7405-ENG-48. 10p. (CONF-880873—1). NTIS, PC A02/MF A01;1; GPO Dep. Order Number DE88010562/JAW.

From 6. international coral reef symposium; Townsville, Australia (8 Aug 1988).

The objective of this review is to develop and organize a conceptual framework for the discussion of the mechanisms of reef growth turn-on and turn-off. An improved understanding of the causes, mechanisms and short-term symptoms of reef turn-on/turn-off is essential if we are to deal with the challenge of understanding and managing reef resources under conditions of both immediate

anthropogenic impacts and long-term climatic changes. The discussion attempts to provide a basis for identifying the future research and conceptual synthesis that can best improve both our understanding of the causes of past transitions in reef development and our abiltiy to predict with confidence the future outcome of presently changing conditions.

5202 Chemicals Monitoring And Transport

REFER ALSO TO CITATION(S) 39103, 39106, 39108, 39112, 39113, 39174, 39175, 39181, 39182, 39184, 39188, 39343, 39619, 40012, 40068, 40182, 40492, 40502, 41162, 41165, 41230, 41257, 41258, 41290, 41291, 41292, 41294, 41299, 41301, 41302, 41303, 41304, 41305, 41306, 41317, 41347, 41376

41340 **(CONF-870551—1) Aquatic toxicology and hazard assessment eleventh symposium: Introduction and summary.** Suter, G.W. II; Lewis, M. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 13p. NTIS, PC A03;3. Order Number DE88011395/JAW.

From 11. American Society for Testing and Materials symposium on aquatic toxicology and hazard assessment; Cincinnati, OH, USA (6 May 1987).

The primary role of the ASTM symposium series in Aquatic Toxicology and Assessment is to provide a forum for the discussion of recent developments that are important to those who perform environmental risk assessments and who work in ecotoxicology environmental chemistry. The success of the Eleventh Symposium in fulfilling this role is reflected in the 38 papers appearing in this publication. The presented papers, continuing the trend of previous meetings, included topics significant to the standard writing process such as chronic endpoints, statistical data analysis, and description of new methodologies. In addition, sessions were devoted to three subjects that are becoming increasingly important to the scientific and regulatory communities. The number of papers in the session on effluent toxicity assessments reflects the increasing importance of the US Environmental Protection Agency's national policy on water quality-based toxics control. The large session on current developments in understanding the fate of chemicals reflects the recent recognition of the importance of realistic exposure assessments.

41349 **(CONF-8806162—1) Sourcing of organic pollutants by stable carbon isotopic analysis.** Bonilla, J.V.; Stamoudis, V.C. (Argonne National Lab., IL (USA)). 1988. Contract W-31109-ENG-38. 4p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88012001/JAW.

From 6. symposium on environmental analytical chemistry: atmospheric chemistry and source apportionment in ambient and indoor atmospheres; Provo, UT, USA (27 Jun 1988).

Determining pollutant sources is one of the major problems in dealing with organic contaminants in the environment. Stable carbon isotope analysis may help elucidate sources of organic pollutants. We investigated the potential of using stable carbon isotope ($\delta^{13}C$) values to determine the sources of these chemicals by obtaining several organic compounds (common solvents) from different suppliers and determining their stable carbon isotopic composition. We report here for the first time stable carbon isotopic data for polychlorinated hydrocarbons. Further, we provide examples of how stable carbon isotopic analysis may be used as a tool to support gas chromatography (GC) and gas chromatography/mass spectrometery (GC/MS) analytical techniques in environmental studies of phenomena such as long range pollutant transport, sourcing, and source apportionment. 9 refs.

41350 **(DOE/PE/16037—T3) Technical and economic data development concerning the LUST Program.** (Eastern Research Group, Inc., Arlington, MA (USA)). Feb 1987. Contract AC01-84PE16037. 69p. NTIS, PC A04/MF A01;1; GPO Dep. Order Number DE88012308/JAW.

The US Environmental Protection Agency (EPA) is developing a regulatory program to prevent groundwater contamination due to leading underground storage tanks (LUST). These tanks are used by all gasoline service stations and by a number of other energy-related industries. New regulations under the EPA LUST program are expected to allow installation of only corrosion-resistant tanks (e.g., fiberglass tanks) and to require replacement of some existing steel tanks. This report describes the EPA program and presents technical, economic, and financial background information on the energy industries likely to be affected. This information will be used in future studies to examine the economic impact of the LUST regulations.

41351 **(GKSS—87/E/57) Instrumental neutrons activation analysis of Elbe river suspended particulate matter separated according to the settling velocities.** Niedergesaess, R.; Racky, B.; Schnier, C. (GKSS-Forschungszentrum Geesthacht G.m.b.H., Geesthacht-Tesperhude (Germany, F.R.)). 1987. 14p. Reprint from J. Radioanal. Nucl. Chem., Articles (1987) v. 114(1) p. 57-68.

Suspended particulate matter in Elbe river water near Hamburg has been separated into different fractions by pouring the samples into special sedimentation tubes called Atterberg cylinders. The fractions are obtained by decanting the water after different settling periods, and by filtrating the decanted part. The analysis is done by neutron activation in the absolute mode, after irradiation periods of 5 min and 3 days. Mean settling velocities of the SPM-mass and the elements determined have been calculated. (orig.)

41352 **(NP—8770287) Heavy metal concentrations in the Mediterranean estuarine regions of the Rhone, Ebro, Po, and Arno rivers.** Dorten, W.S. (Bonn Univ. (Germany, F.R.). Mathematisch-Naturwissenschaftliche Fakultaet). 8 Aug 1986. 273p. (In German). NTIS (US Sales Only), PC A12/MF A01. Order Number DE88770287/JAW.

The preservation of the coast line and estuary ecosystems requires an efficient monitoring of toxic substances. The early detection of damages and adequate measures to avoid or eliminate them are based on investigations into the behaviour of the pollutants concerned. The study analyzes the following metals found in samples of water and sediments of the Rhone, Ebro, Po and Arno estuaries: Zinc, cadmium, lead, copper, nickel, cobalt, and mercury. The results obtained using analytical methods such as atomic absorption spectroscopy, results obtained using analytical methods such as atomic absorption spectroscopy, X-ray fluorescence spectrometry and voltametry allow for statements as to the typical reaction paths metals can take passing estuaries. The study assesses the following essential transport mechanisms: 1. Soluble heavy metals subject to complex formation and exchanges, 2. combined particular metals largely influencing coastal sedmentation processes, 3. with the salinity increasing in the estuary mixing zone particles characterised by their high adsorption affinity separate as flocculent precipitations which are extremely slow to deposit. (orig./RB) With 121 figs., 26 tabs.

41353 **(PB—88-147871/XAB) Wastes from water-treatment plants: literature review, results of an Illinois survey, and effects of alum-sludge application to cropland.** Lin, S.D.; Green, C.D. (Illinois State Water Survey, Peoria (USA). Water Quality Section). Nov 1987. 199p. (SWS/CR—429). NTIS, PC A09/MF A01.

The objectives of the study were to update information on the characteristics and management of wastes from water-treatment plants and to assess the benefits and risks of alum-sludge application to cropland. The report has three major sections: a literature review; a summary of results of a survey of Illinois water-plant wastes; and a discussion of findings from a study of alum sludge for agricultural uses. The literature survey addresses characteristics and management of sludge. The literature review section discusses laws and regulations (PL 92-500, PL 94-580, PL 93-523) regarding waste disposal from water-treatment plants.

41354 **(PB—88-170840/XAB) National Surface Water Survey: National Stream Survey Phase 1 pilot survey. Final report.** Messer, J.J.; Eshleman, K.N.; Stambaugh, S.M.; Kaufmann, P.R. (Lockheed Engineering and Management Services Co., Inc., Las Vegas, NV (USA)). Dec 1986. 200p. NTIS, PC A09/MF A01.

See also PB—88-140298.

A pilot survey of streams in the Southern Blue Ridge Province was conducted by the U.S. Environmental Protection Agency during the spring and summer of 1985 as a means of testing a pro-

posed methodology for (1) determining the present extent and location of acidic and low-acid neutralizing capacity (ANC) streams in the United States, and (2) classifying sampled streams that are representative of important classes of streams and, therefore, should be selected for intensive study or long-term monitoring. Potentially important uses of the data in the context of environmental assessment of acidification are presented by way of example.

41355 **(PB—88-186333/XAB) Powerboat engine discharges as a nutrient source in high-use lakes. Research technical completion report.** Hallock, D.; Falter, C.M. (Idaho Univ., Moscow (USA). Dept. of Fish and Wildlife). Oct 1987. 55p. NTIS, PC A04/MF A01.

Modern internal-combustion engines burn fuels containing various nitrogen and phosphorus compounds as additives, e.g., alkyl phosphate, amine phosphate, etc. Nitrogen oxides are also formed from atmospheric gases during the combustion process. In the case of marine engines, exhaust gases and incompletely burned fuel and oil are discharged directly into the water. In-situ enclosure experiments were conducted to quantify nitrogen and phosphorus additions and the biological response from two- and four-cycle outboard engines.

41356 **(PB—88-195722/XAB) Field operations and quality assurance/quality control for Direct/Delayed Response Project soil-mapping activities in the Southern Blue Ridge Region.** Lammers, D.A.; Cassell, D.L.; Lee, J.J.; Stevens, D.L.; Campbell, W.G. (Environmental Protection Agency, Corvallis, OR (USA). Environmental Research Lab.). Apr 1988. 139p. (EPA—600/3-88/016). NTIS, PC A07/MF A01.

See also PB—88-171301.

The Direct/Delayed Response Project is a three-level program designed to address concern over potential acidification of surface waters by atmospheric deposition within the United States. The mapping phase of the Southern Blue Ridge Region soil survey was conducted during the fall and winter of 1985-86 to characterize spatial distribution of soils, land use, vegetation, depth to bedrock, and lithology of 35 watersheds thought to be susceptible to acidic deposition. The document describes planning activities and summarizes field operations and quality assurance/quality control activities associated with mapping of the region.

41357 **(PB—88-196076/XAB) Toxicity of sediment-incorporated drilling fluids.** Clark, J.R.; Patrick, J.M. (Environmental Protection Agency, Gulf Breeze, FL (USA). Environmental Research Lab.). 1987. 6p. (EPA—600/J-87/312). NTIS, PC A02/MF A01.

Pub. in Marine Pollution Bulletin, Vol. 18, No. 11, 600-603(Nov 1987).

The 24, 96, or 168-h LC50s of four used drilling fluids or barite incorporated into sediment were determined in toxicity tests with lancelets (Branchiostoma caribaeum), a benthic chordate. The number of lancelets that did not burrow into contaminated sediments was used to calculate EC50s at the same times that LC50s were determined. Observations of the burrowing behavior allowed quantitation of effects after 24-h exposures to each of the drilling fluids whereas lancelet mortality was sufficient to calculate 24-h LC50s for only one drilling fluid. Drilling fluids were less toxic to lancelets when incorporated into sediments than to mysids (Mysidopsis bahia) or benthic invertebrate communities in water-column exposures.

41358 **(PB—88-202064/XAB) Selected chemical contaminants in surface sediments of Commencement Bay and the Tacoma waterways, Washington, USA (revised).** Schults, D.W.; Ferraro, S.P.; Ditsworth, G.R.; Sercu, K.A. (Environmental Protection Agency, Narragansett, RI (USA). Environmental Research Lab.). 1987. 27p. (EPA—600/J-87/341). NTIS, PC A03/MF A01.

Pub. in Marine Environmental Research Vol. 22, 271-295(1987).

Eight metals, 21 organic priority pollutants, and 11 other contaminants and contaminant-related sediment characteristics were measured in surface sediments (upper 2 cm) at 21 locations in Commencement Bay and the Tacoma Waterways, Washington. Summary statistics were calculated and statistical approaches were applied to subsets of the data to classify sediment contamination. High concentrations of some contaminants appeared to be related to proximity to sources of contaminants. Depositional vectors and chemical-adsorption processes may also influence the spatial distribution of sediment contamination in the study area.

41359 **(PB—88-204748/XAB) Research activity descriptors FY 88: October 1987-September 1988. Technical report.** (Lockheed-EMSCO, Las Vegas, NV (USA)). Mar 1988. 240p. NTIS, PC A11/MF A01.

This document was prepared to provide scientists and administrators, both within and outside the U.S. Environmental Protection Agency, the most-current information on the research strategy in the Aquatic Effects Research Program (AERP) and the projects contributing to that strategy. The AERP is a program within the Acid Deposition and Atmospheric Research Division of the Office of Ecological Processes and Effects Research within the Environmental Protection Agency's Office of Research and Development. The AERP also is part of the National Acid Precipitation Assessment Program (NAPAP), a research program comprised of seven federal agencies for which the Environmental Protection Agency is the lead. The materials contained herein represent a brief description of AERP research activities funded in FY1987 and FY1988 and those proposed for funding in FY1989. For information on currently funded research, the technical contact indicated on each summary should be consulted.

41360 **(PNL-SA—15399) Temporal trends of contaminants recorded in sediments of Puget Sound.** Crecelius, E.A.; Curl, H.C. Jr. (Pacific Northwest Lab., Richland, WA (USA)). Mar 1988. Contract AC06-76RL01830. 12p. (CONF-880374—1). NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88008204/JAW.

From 1. annual meeting on Puget Sound research; Seattle, WA, USA (18 Mar 1988).

This paper discusses the temporal trends of contamination that can be inferred from the chemical composition of age-dated sediment cores from central Puget Sound. The fine-grain sediment (less than 10% sand) of the deep region (>150m) of central Puget Sound, which accumulates relatively undisturbed sediment at a rate of approximately 1 cm per year, provides a useful record of the history of contamination. 21 refs., 4 figs.

41361 **(WU—EE97) Evaluation of sorbent use for retrieval of hazardous sunken liquids.** Ross, B. (Waterloo Univ., Ontario (Canada)). Dec 1987. 31p. (MICROLOG—88-02061). Environmental Protection Directorate, Environment Canada, 351 St. Joseph Blvd., Terrasses de la Chaudiere, Ottawa, Ont., Canada K1A 0E7; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

A variety of commercially available sorbent products were tested using six liquid chemicals all with a density greater than that of water. The sorbents were tested both in test liquid alone and test liquid sunk in water and were evaluated for capacity, water pick-up and number of reuses. Changes in sorbent performance in flowing water conditions were also examined. The polypropylene, polyethylene, and cross-linked polymer bead sorbents showed the greatest potential for sunken chemical resistance and lower water pick-up than the other sorbents tested. Greatest reusability was demonstrated in the polypropylene and polyethylene sorbents. With few exceptions, the performances of those sorbents tested in flowing water were not significantly affected under the testing conditions used. 6 refs., 18 figs., 7 tabs.

41362 **Direct characterization of methanogens in two high-rate anaerobic biological reactors.** Kobayashi, H.A.; De Macario, E.C.; Williams, R.S.; Macario, A.J.L. (BP America, Cleveland, OH (USA)). *Applied and Environmental Microbiology;* **54**: No. 3, 693-698(Mar 1988). Contract FG02-84ER13197.

High-rate reactors are gaining popularity for anaerobic biological treatment of industrial waste water. The methanogenic flora from two types of turbulent, high-rate reactors was studied by im-

munologic methods as well as by phase-contrast, fluorescence, and scanning electron microscopy. The reactors were a fluidized sand-bed biofilm ANITRON reactor and an ultrafiltration membrane-associated suspended growth MARS reactor. Conventional microscopic methods revealed complex mixtures of microbes of a range of sizes and shapes, among which morphotypes resembling Methanothrix spp. and Methanosarcina spp. were noticed. Precise identification of these and other methanogens was accomplished by antigenic fingerprinting with a comprehensive panel of calibrated antibody probes of predefined specificity spectra. The methanogens identified showed morphotypes and antigenic fingerprints indicating their close similarity with the following reference organisms: methanobacterium formicicum MF and Methanosarcina barkeri W in the ANITRON reactor only; Methanosarcina barkeri R1M3, M. mazei S6, Methanogenium cariaci JR1, and Methanobrevibacter arboriphilus AZ in the MARS reactor only; and Methanobrevibacter smithii ALI and Methanothrix soehngenii Opfikon in both reactors. Species diversity and distribution appeared to be, at least in part, dependent on the degree of turbulence inside the reactor.

41363 **A microcosm procedure for determining safe levels of chemical exposure in shallow-water communities.** Giddings, J.M. (Environmental Sciences Div., Oak Ridge National Lab., Oak Ridge, TN (US)). pp 121-131 of Community toxicity testing. Cairns, J. Philadelphia, PA; ASTM (1986). (CONF-8505158—).

From ASTM symposium on community toxicity testing; Colorado Springs, CO, USA (6 May 1985).

This paper describes a method for determining safe levels of chemical exposure in shallow-water communities, using laboratory microcosms as test subjects. The safe level is considered to be the maximum exposure that causes no persistent, ecologically significant changes in the ecosystem. Shallow freshwater communities in ponds, lakes, and rivers are good experimental subjects for research on contaminants, and environmental toxicologists have measured their responses to a variety of chemicals. Certain patterns of community effects have been observed, including a decline in net primary production or the production; respiration ratio, concomitant changes in water chemistry, and changes in community composition brought about by interactions among sensitive and resistant populations. The same patterns can be reproduced in microcosms containing natural sediment, water, and communities of submersed aquatic plants (macrophytes). In experiments completed at Oak Ridge National Laboratory, microcosm-derived estimates of safe exposure levels were confirmed using outdoor artificial ponds, suggesting that the microcosm procedure can be an efficient and economical means of determining safe levels for shallow-water communities. Details of microcosm construction, techniques for monitoring ecological variables in microcosms, and an experimental design for determining safe exposure levels are provided here.

5203 Radioactive Materials Monitoring And Transport

REFER ALSO TO CITATION(S) 39311, 39325, 39343, 39359, 39413, 39416, 39419, 39614, 39859, 40577, 41140, 41162, 41257, 41258, 41262, 41263, 41264, 41270, 41271, 41284, 41285, 41317, 41318, 41568

41364 **(CEA-CONF—9222) Application of tritium in hydrology and in industry.** Margrita, R. (Compagnie ORIS Industrie, 91 - Gif-sur-Yvette (France)). 1986. 6p. (In French). (CONF-8604266—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88753905/JAW.

From Tritium meeting; Dijon, France (23 Apr 1986).

The paper describes some applications of tritium as a tracer. Aquifers are characterized by tritiated water produced by nuclear explosions. Sensitivity is increased by electrolytic enrichment of samples. Artificial injection of tritiated water are also realized to study aquifers for enhanced oil recovery, geothermal wells or salt extraction. Some examples of industrial use of tritiated water are given: permeation, diffusion, autoradiography, chemical or civil engineering.

41365 **(DOE/EV/03566—54) The distribution of some chemical elements between dissolved and particulate phases in the ocean: Progress report, 1 April 1987-31 March 1988.** Spencer, D.W.; Bacon, M.P.; Sachs, P.L.; Fleer, A.P.; Shafer, D.K.; Belastock, R.A.; Hammar, T.R. (Woods Hole Oceanographic Institution, MA (USA)). 1988. Contract AC02-76EV03566. 38p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88010181/JAW.

The long-range goal of our research under this contract is an understanding of the processes that control the distribution and fate of chemical species in the ocean, with a particular emphasis on species which are reactive with respect to uptake by marine particulate matter. Such an understanding is essential in predicting the fate of reactive pollutants, such as heavy metals and radionuclides, that are released to the environment as a consequence of energy-producing activities. In pursuit of this goal we have, during the present contract period, been devoting all of our effort to participation in the Shelf-Edge Exchange Processes (SEEP) program. 23 refs., 7 figs., 4 tabs.

41366 **(FRCEA-TH—64) Uranium and radium geochemistry. Radioactive disequilibrium in natural waters.** Beaucaire, C. (Paris-7 Univ., 75 (France); CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Dept. de Physico-Chimie). Sep 1987. 217p. (In French). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88753965/JAW.

Rock-water interactions play a primary part in uranium-series disequilibrium either by different chemical behavior or by recoiling alpha emitting nuclei in solution. Three series of thermal water containing CO/sub 2/ (Vichy, Vals and Cezallier) and one from Lodeve uranium deposit are studied to define parameters (pH, Eh, pCO/sub 2/, T,...) controlling studied nuclei. For U complexation by carbonates is in competition with redox conditions. Ra is coprecipitated by barium. For thermal waters keeping their deep characteristics there is a low disequilibriums /sup 234/U-/sup 238/U between 1 and 2. On the contrary important disequilibrium (up to 12) in Vichy Saint Yorre water are due to secondary remobilization. In the same way for these waters /sup 234/U and /sup 226/Ra are correlated. Then leaching is essential for the radioactive disequilibrium but alpha recoil of /sup 234/Th is of secondary importance in this case.

41367 **(NAGRA-NTB—87-16) Trace element and microbiological studies of alcaline groundwaters in Oman, Arabian Gulf: a natural analogue for cement pore-waters.** Bath, A.H.; Christofi, N.; Neal, C.; Philp, J.C.; Cave, M.R.; McKinley, I.G.; Berner, U. (British Geological Survey, Keyworth (UK). Fluid Processes Research Group; Dep. of Biological Sciences, Napier Colledge, Edinburgh (UK); Institute of Hydrology, Wallingford, Oxfordshire (UK); Dep. of Biological Sciences, Napier Colledge, Edinburgh (UK); British Geological Survey, Keyworth (UK). Fluid Processes Research Group; 2314000CH). (Nationale Genossenschaft fuer die Lagerung Radioaktiver Abfaelle (NAGRA), Baden (Switzerland)). Jul 1987. 80p. Nagra, CH-5401 Baden, Switzerland.

Further confirmatory evidence is being sought to demonstrate the beneficial influence of a highly alkaline cementitious repository environment on the solubilities of many radionuclides and on the inhibition of microbial growth. The decreases in solubilities are predicted theoretically by chemical thermodynamic modelling, but uncertainties occur in the data and ionic species relevant to the highly alkaline environment. There are few direct laboratory or natural observations of microbial viabilities at high pH. Furthermore, because repository safety analysis involves prolonged timescales, the evolution of the responses to high alkalinity in a natural environment must be considered. This report describes a study, funded jointly by UK Nirex Ltd., and Nagra, of some rare occurrences of highly alkaline natural groundwater. Both trace element abundances and microbiology were investigated. Although the study highlights many practical and analytical difficulties in obtaining conclusive evidence from natural systems, it also indicates that further such 'natural analogue' investigations could give valuable

data to constrain and complement theoretical predictions. 69 refs., 14 figs., 14 tabs.

41368 (PB—88-197306/XAB) Two test procedures for radon in drinking water: interlaboratory collaborative study. Whittaker, E.L.; Akridge, J.D.; Giovino, J. (Lockheed Engineering and Management Services Co., Inc., Las Vegas, NV (USA)). Sep 1987. 55p. NTIS, PC A04/MF A01.

Two analytical methods for the determination of radon in water concentration were tested in a multilaboratory study with twenty-eight participating laboratories. Eighteen laboratories analyzed prepared samples by the liquid scintillation (LS) method, and twelve laboratories analyzed the same samples by the Lucas Cell (LC) method. A comparison of the grand averages for the three samples with the known values for those samples showed good accuracy for both methods. The accuracy index was not less than 94% for any of the three samples when analyzed by either method. Test results for the LS method showed better precision than test results for the LC method. The average repeatability (within-laboratory) precision for the LS method was 3.6 plus or minus 3.0% at 95% confidence and for the LC method it was 6.4 plus or minus 3.8% at 95% confidence. The average reproducibility (combined within-and between-laboratory) precision for the LS method was 10.2 plus or minus 4.2% at 95% confidence and for the LC method it was 17.6 plus or minus 4.2% at 95% confidence.

41369 (PSI—4) Cyclic metal migration in a groundwater stream. Goerlich, W.; Portmann, W.; Wernli, C.; Linder, P.; Burkart, W. (Paul Scherer Inst. (PSI), Wuerenlingen (Switzerland)). Apr 1988. 7p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88703470/JAW.

The behaviour of dissolved (<0.45 μm) inorganic species (e.g. metals, anions), and changes in relevant properties of polluted river water during infiltration into adjacent groundwater are investigated. Water from the river and from several wells is analyzed for temporal and spacial changes. For many of the measured quantities a pronounced annual cycle is observed. The temperature differences between summer and winter influence biological activity. Growth and degradation of organic material lead to drastic changes in pH and redox conditions in the near infiltration field. During summer, under relatively anoxic conditions, manganese oxides/hydroxides dissolve. In winter, the higher concentration of dissolved oxygen induce reprecipitation of manganese. Trace metal mobility (e.g. Cu, Zn, Cd) is influenced by these annual variations. In the river, daily cycles are observed for many of the measured quantities. These short term variations are induced by photosynthesis and respiration of aquatic biota. The cyclic behaviour disappears during the early stage of infiltration. The changes between river and groundwater can be modelled by a combination of simplified electron transfer and weathering reactions. (author) 11 refs., 5 figs.

41370 (RI—203) Study on contamination of the Baltic Sea within 1981-1983. Saksen, R.; Tajpale, T.K.; Sinkko, K. and others. (Finnatom, Helsinki). (Radievyj Inst., Leningrad (USSR)). 1987. 59p. (In Russian). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88703475/JAW.

The results are presented of joint studies of the radioactive contamination of the Baltic Sea conducted by the Finnish Centre for Radiation and Nuclear Safety (Finland) and V.G. Khlopin Radium Institute (USSR) in 1981-1983. Tritium, /sup 90/Sr, /sup 134,137/Cs, /sup 239,240/Pu, /sup 241/Am and number of gamma-emitting nuclides were determined in samples of water, bottom sediment and hydrobionts of the Baltic Sea. The results of intercalibration of the methods for /sup 90/Sr and /sup 137/Cs determination in water samples are compared. It is shown that there are no changes in the radioactivity in the Baltic Sea due to Baltic NPP's. A spread is noted of the technogenic radioactive conmtamination penetrating from the North Sea in the waters of the Baltic Sea. 11 refs.; 5 figs.; 25 tabs.

41371 (STUK-A—82) Finnish studies on radioactivity in the Baltic Sea in 1987. Supplement 8 to Annual Report 1987 STUK-A--74. Ikaeheimonen, T.; Ilus, E.; Saxen, R. (Finnish Centre for Radiation and Nuclear Safety, Helsinki). May 1988. 40p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88754091/JAW.

Monitoring of radioactive substances in the Baltic Sea was continued within the framework of the Finnish national monitoring programme. The only regularly detected gamma nuclides in sea water were ^{40}K, ^{134}Cs and ^{137}Cs. The ratio $^{134}Cs/^{137}Cs$ in surface water samples was 0.36+-0.01. The activity concentrations of ^{137}Cs have became more evenly distributed during the last year, so that in the surface water of the Baltic proper the values were 100-200 Bq m^{-3}, in the Gulf of Finland 200-300 Bq m^{-3}, in the Bothnian Sea 300-400 Bq m^{-3} and in the Bothnian Bay about 100 Bq m^{-3} in 1987. The sedimentation of the Chernobyl fallout into the bottom sediments of the open sea basins only began to increase in 1987. The addition of ^{137}Cs and other fallout nuclides was strongest at the XV 1 station in the eastern part of the Gulf of Finland, where the total deposition of ^{137}Cs was about 18 kBq m^{-3} during the last year. No areal differences were found in the fish samples caught from the coastal waters of Finland in 1987. In pike and cod the ^{137}Cs values have slightly increased since 1986, being now about five times (15-30 Bq kg^{-1} fresh weight) the values before the Chernobyl accident. The activity concentrations of ^{90}Sr (0.030-0.11 Bq kg^{-1} fresh weight) were at the same level as in 1985 and the preceding years.

5204 Thermal Effluents Monitoring And Transport

REFER ALSO TO CITATION(S) 41373

41372 (OH/RD—87/233/K) Atikokan TGS [Thermal Generating Station] aquatic studies, August and October 1985. Haymes, G.T.; Kwik, J.K. (Ontario Hydro Research Div., Toronto (Canada)). 19 Oct 1987. 55p. (MICROLOG—88-01719). Ontario Hydro Research Division, Editorial Section, 800 Kipling Ave., Toronto, Ont., Canada M8Z 5S4; $10.00 CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

Physical, chemical and biological parameters were monitored in the Atikokan, Ontario, Generating Station cooling circuit. With the exception of temperature and oxygen profiles in Moose Lake, physical and chemical parameters measured in 1985 were similar to those of previous years. In Moose Lake, the thermocline was drawn below the level of the station's intake and a lens of oxygen depletion was apparent at the depth of the thermocline. The abundance and distribution of macrophytes in the areas selected for intensive study had increased since 1983. The abundance of lodea canadensis in Snow Lake and East Bay of Ice Lake had increased since 1983. The catches of fish in larval tows, beach seines and gill nets were similar to previous years, except that the relative abundance of blacknose shiner in beach seine hauls continued a decline initiated in 1984. 16 refs., 16 figs., 17 tabs.

5205 Site Resource And Use Studies

REFER ALSO TO CITATION(S) 39103, 39411, 39413, 39414, 41330

41373 (DP—1739-8) Comprehensive Cooling Water Study: Volume 8, Waterfowl, Savannah River Plant: Final report. Mackey, H.E. (ed.). (Savannah River Lab., Aiken, SC (USA)). Sep 1987. Contract AC09-76SR00001. 120p. NTIS, PC A06/MF A01;1; GPO Dep. Order Number DE88010408/JAW.

Large numbers of waterfowl have been present on the Savannah River Plant (SRP) since public access to the site was terminated in the early 1950s. Thirty-one species of waterfowl have been documented as occurring on the SRP. The Savannah River Ecology Laboratory (SREL) has been conducting waterfowl research and surveys on the site for the past 15 years. This research has included work on waterfowl use of the SRP, wood duck reproductive biology, and waterfowl wintering ecology. Waterfowl use of the site has been assessed through aerial surveys of the Par Pond system and the SRP Savannah River swamp and through roost counts in the Steel Creek drainage. Aerial surveys have proven to be the most successful method of estimating waterfowl numbers each winter. The most abundant waterfowl species in the Savannah River swamp were consistently mallards and wood ducks, as determined by numbers counted. Both of these species have increased on

the SRP. Mid- winter mallard numbers in both the Atlantic Flyway and in South Carolina have decreased during the same time period. In the SRP Savannah River swamp, the Steel Creek Delta and the sloughs between the Four Mile Creek and Pen Branch deltas had more mallards than did the Beaver Dam Creek Delta or the Pen Branch Delta. No differences were found for wood duck counts between the Four Mile Creek Delta sloughs, the Steel Creek Delta, or the Beaver Dam Creek Delta. The Savannah River swamp was used extensively for foraging by both mallards and wood ducks. 58 refs., 52 figs., 19 tabs.

41374 **(DS—8705) Wave climate study northern coast of British Columbia. Environmental studies revolving funds, No. 059.** (Dobrocky Seatech Ltd., Sidney, British Columbia (Canada)). May 1987. 98p. Unlimited audience, publicly available.

This report describes a wave data collection program in northern British Columbia from July 1984 to March 1985. The objective was to extend the existing data base for estimating the spatial and interannual variability in the wave climate as well as to provide information on the wave climate during the months when data were missing during the previous program. Five instrument systems were operated: directory wave buoys (WAVEC) at Langara west, and ENDECO at Bonilla Island, non-directional wave buoys at Hecate Strait and Queen Charlotte Sound, and a satellite-transmitting meteorology station at McKenny Island. The observed wave climate shows trends similar to those recorded during the previous program. The wave climate showes a strong seasonal variability with a relatively quiescent summer period (June to September) with low waves (H/sub s/<2 m) and a storm period (October to March) of significantly higher waves. The transition period between "summer" and "winter" is very abrupt with October being one of the stormiest months of the year. The most severe conditions were observed in Queen Charlotte Sound in November. There was considerable reduction of wave energy from Queen Charlotte Sound to Bonilla Island. In Dixon Entrance, the most energetic directions had consistently lower peak periods. The directions of waves and winds recorded at the Langara Island lighthouse were hot in phase, indicating that the winds from shore station are not representative of over-the-water winds. 7 refs., 10 tabs., 1 fig.

41375 **(GL—8703) Design of an iceberg scour repetitive mapping network for the Canadian east coast. Environmental studies revolving funds, No. 043.** (Geonautics Ltd., St. John's, Newfoundland (Canada)). Mar 1987. 59p. Unlimited audience, publicly available.

This report recommends the establishment of a repetitive seabed mapping network for monitoring the recurrence rate of iceberg-seabed interactions on the eastern Canadian continental shelf. The selection of control areas and corridors is based on an analysis of predicted grounding densities, generated by a computer model developed at the Atlantic Geoscience Centre, combined with available information on existing iceberg scours, observed and interpreted groundings and scours, seabed geologic conditions, and existing geophysical data. The recommended network includes one control mosaic on Makkovik Bank, two control corridors (long, narrow swaths) on Hamilton Bank and four possible control corridors on Grand Bank. This network covers a variety of water depths and surficial geologic conditions over a broad geographic range, thus ensuring that the results will be applicable to many other areas on the shelf. Besides providing quantitative data on the recurrence rates of iceberg impacts, the repetitive mapping program will also provide useful information concerning the rate of obliteration of existing iceberg scour features and sediment mobility within the control areas and corridors. 29 refs., 4 figs.

41376 **(ORNL/M—259) National Surface Water Survey: National Stream Survey: Phase 1, Pilot survey.** Messer, J.J.; Ariss, C.W.; Baker, J.R.; Drouse, S.K.; Eshleman, K.N.; Kaufmann, P.R.; Linthurst, R.A.; Omernik, J.M.; Overton, W.S.; Sale, M.J. (Environmental Protection Agency, Washington, DC (USA). Office of Research and Development; Environmental Protection Agency, Corvallis, OR (USA). Environmental Research Lab.; Environmental Protection Agency, Las Vegas, NV (USA). Environmental Monitoring Systems Lab.). Dec 1986. Contract AC05-84OR21400. 196p. (EPA/600/4—86/026). NTIS, PC A09/MF A01;1; GPO Dep. Order Number DE88011130/JAW.

A pilot survey of streams in the Southern Blue Ridge Province was conducted by the US Environmental Protection Agency during the spring and summer of 1985 as a means of testing a proposed methodology for (1) determining the present extent and location of acidic and low acid neutralizing capacity (ANC) streams in the United States and (2) classifying sampled streams that are representative of important classes of streams and, therefore, should be selected for intensive study or long-term monitoring. Data from the National Stream Survey Phase I-Pilot Survey are presented in the context of evaluating a statistical sampling design, logistics plan, quality assurance plan, and data management program. Results indicate that the design is capable of producing robust population estimates for important chemical variables using a single synoptic sampling of streams, and that it has the potential of producing a relatively simple geochemical classification of streams. The study showed that, with 95% confidence, less than 3.2% of the combined length of streams in the target population exhibited average spring non-episodic pH values below 6.4 (the lowest value for which a confidence level could be used). The best estimate of the percentage of stream length with ANC less than or equal to 200 μeq L/ sup {minus}1/ was 74.4%.

41377 **(PB—88-864913/XAB) Water resources: effects of land use and urbanization. September 1981-May 1988 (Citations from the NTIS data base). Report for September 1981-May 1988.** (National Technical Information Service, Springfield, VA (USA)). May 1988. 63p. NTIS PC N01/MF N01.

Supersedes PB—87-861159.

This bibliography contains citations concerning the effects of land use and urban development on water-supply quality and quantity. Topics include appropriate local, state, and federal government policies, and utilization of mathematical models as predictive tools. Studies performed at specific localities are included if they provide comprehensive strategies that can be applied to other locations. (This updated bibliography contains 123 citations, 11 of which are new entries to the previous edition.)

5206 Regulations

REFER ALSO TO CITATION(S) 39170, 39171, 41276, 41278, 41281, 41335, 41350, 41353, 41395

41378 **(AD-A—190941/5/XAB) Installation-Restoration Program records search for Air Force Plant 42, California. Final report.** (CH2M Hill, Gainesville, FL (USA)). Oct 1983. 235p. NTIS, PC A11/MF A01.

This report provides the Installation-Restoration Program (IRP) Phase I-Records Search for Air Force Plant 42, Palmdale, California. This is a report of a study conducted to identify past potentially hazardous-material disposal sites. Interviews and document searches were conducted to determine sites that were potentially contaminated.

41379 **(AD-A—190942/3/XAB) Installation-Restoration Program. Phase 2. Confirmation/quantification Stage 1. US Air Force Plant Number 42, Palmdale, California. Volume 1. Final report, September 1985-February 1987.** (Engineering-Science, Inc., Pasadena, CA (USA)). 20 Feb 1987. 532p. NTIS, PC A23/MF A01.

See also Volume 2, AD-A190 943.

An Installation Restoration Program (IRP) Phase II, Stage 1 investigation was conducted at USAF Plant 42 in Palmdale, California, to confirm the presence or absence of contamination at 23

sites. Contamination was suspected at the sites as a result of past spills, leaks, or waste-disposal practices. A field-investigation program was conducted, consisting of soil boring and sampling, groundwater sampling, and chemical analysis of environmental samples (water and soils) for suspected contaminants. No significant contaminants were found at 17 of the sites. Fuel contamination (petroleum hydrocarbons or oil & grease) was detected at 5 sites, 3 of which also had volatile organics present. Remedial action was recommended for 2 sites because of the location and amount of contaminants detected.

41380 **(AD-A—190943/1/XAB) Installation-Restoration Program. Phase 2. Confirmation/quantification Stage 1. US Air Force Plant Number 42, Palmdale, California. Volume 2. Final report, September 1985-February 1987.** (Engineering-Science, Inc., Pasadena, CA (USA)). 20 Feb 1987. 669p. NTIS, PC A99/MF A01.

See also Volume 1, AD-A190 942.

An Installation-Restoration Program (IRP) Phase II, Stage 1 investigation was conducted at USAF Plant 42 in Palmdale, California, to confirm the presence or absence of contamination at 23 sites. Contamination was suspected at the sites as a result of past spills, leaks, or waste disposal practices. A field investigation program was conducted, consisting of soil boring and sampling, groundwater sampling, and chemical analysis of environmental samples (water and soils) for suspected contaminants. No significant contaminants were found at 17 of the sites. Fuel contamination (petroleum hydrocarbons or oil & grease) was detected at 5 sites, 3 of which also had volatile organics present. Remedial action was recommended for 2 sites because of the location and amount of contaminants detected.

41381 **(AD-A—190945/6/XAB) Installation-Restoration Program records search for Air Force Plant 6, Georgia. Final report.** (CH2M Hill, Gainesville, FL (USA)). Mar 1984. 253p. NTIS, PC A12/MF A01.

Department of Defense (DoD) policy, directed by Defense Environmental Quality Program Policy Memorandum (DEQPPM) 81-5, is to identify and fully evaluate suspected problems associated with past hazardous-material disposal sites on DoD facilities, control the migration of hazardous contamination from such facilities, and control hazardous to health and welfare that may have resulted from these past operations.

41382 **(AD-A—191018/1/XAB) Installation Restoration Program. Phase 2. Confirmation/quantification Stage 1. Bergstrom AFB, Texas. Volume 1. Final report, March 1984-August 1986.** (Radian Corp., Austin, TX (USA)). 27 Apr 1987. 153p. NTIS, PC A08/MF A01.

See also Volume 2, AD-A191 019.

The Department of Defense's Installation-Restoration Program (IRP) is a four-phase program to identify past waste-disposal practices, evaluate environmental impacts, propose mitigation measures, and remediate environmental problems. Phase I of the IRP is an initial assessment and records search to locate potential environmental problems associated with waste-disposal practices. The Phase II field study was conducted between March 1984 and August 1986. The investigation focused on whether environmental contamination had occurred, the magnitude and extent of the contamination, and the environmental consequences of migrating pollutants. Nine coreholes and nine groundwater monitoring wells were drilled, and sampled. Contaminants were detected in the soil and groundwater at most of the sites. The contaminants detected in the highest quantities in the groundwater were lead and benzene. However, the shallow groundwater at the base is not used for drinking water. Shallow groundwater use outside the base is unknown, but it is not believed to include drinking water supplies. Additionally, the existing aquifers are thin and discontinuous on the base so that no known immediate treat to human health exists. Each of the eleven sites was categorized according to Air Force criteria: Category I - no further investigation required, Category II - additional work needed, or Category III - institute remedial action. All sites were Category II.

41383 **(AD-A—191021/5/XAB) Installation-Restoration Program records search for Air Force Plant 85, Ohio. Final report.** (CH2M Hill, Gainesville, FL (USA)). Feb 1984. 147p. NTIS, PC A07/MF A01.

See also AD-A191 020.

This report provides the Installation Restoration Program (IRP) Phase I-Records Search for Air Force Plant 85, Columbus, Ohio. This is a report of a study conducted to identify past potentially hazardous-material disposal sites. Interviews and document searches were conducted to determine sites that were potentially contaminated.

41384 **(AD-A—191022/3/XAB) Installation Restoration Program Phase 2. Confirmation/quantification Stage 2. Bulk fuel-storage area fuel-spill investigation. Final report, 8 February 1985-30 September 1987.** Williams, J.; Johnson, R. (Weston (Roy F.), Inc., West Chester, PA (USA)). Oct 1987. 205p. NTIS, PC A10/MF A01.

Weston was retained by the United States Air Force Occupational and Environmental Health Laboratory (USAFOEHL) to provide general engineering, hydrogeological, and analytical services. USAFOEHL assisted in analysis and remediation of a JP-4 spill that had occurred at the base. McGAFB has identified the source of the spilled fuel as the lines associated with the now inactive railroad off-loading facility (see Figure ES-1). The leak was effectively stopped by permanently disconnecting these lines from the fuel system. Therefore, the following Technical Scope of Work deals only with the second and third aspects of a fuel spill evaluation. USAFOEHL issued Task Order 3 of this contract dated 20 July 1984 authorizing Weston to perform an investigation at the base Bulk Fuel Storage Area. As the primary parameters for evaluation of fuel migration and subsequent groundwater contamination, Weston used the following analytes: benzene, toluene, and xylenes (BTX).

41385 **(AD-A—191023/1/XAB) Installation Restoration Program. Phase 1. Records search. Air Force Plant 78, Brigham City, Utah.** (Engineering-Science, Inc., Atlanta, GA (USA)). Mar 1984. 162p. NTIS, PC A08/MF A01.

This report provides the Installation-Restoration Program (IRP) Phase I-Records Search for Air Force Plant 78, Morton-Thiokol, Brigham City, Utah. This is a report of a study conducted to identify past potentially hazardous-material disposal sites. Interviews and document searches were conducted to determine sites that were potentially contaminated.

41386 **(AD-A—191024/9/XAB) Installation Restoration Program. Phase 2. Confirmation/quantification Stage 1 for Air Force Plant PJKS, Watertown, Colorado. Final report, October 1985-October 1986.** (Engineering-Science, Inc., Denver, CO (USA)). 6 Oct 1986. 907p. NTIS, PC A99/MF E04.

A field investigation was conducted to confirm or deny the presence of hazardous wastes at eight sites at Air Force Plant PJKS near Waterton, Colorado. Activities at the plant that could have generated hazardous wastes include the development and testing of rocket engines. The field program included sampling of surface waters, soils, and sediments, and the installation and sampling of eight ground-water monitoring wells. Hazardous substances found at the eight sites included TCE and other halocarbons, NDMA (a decomposition product of hydrazine), phenols, and trace amounts of heavy metals, including arsenic, hexavalent chromium, and selenium. Elevated levels of radiation were detected in ground waters downgradient from a landfill known to contain a small amount of low-level radioactive magnesium-thorium alloy. Since natural uranium mineralization occurs within the area, the background level of radiation needs to be established before the significance of the measured radiation can be determined. Contamination of soils and sediments was determined to be of low significance because of the low levels of contamination and a lack of pathways for offsite migration. Contamination of surface and ground waters at some sites was judged to be moderately significant because the contaminants occurred at concentrations exceeding standards or guidelines to protect human health, and the potential for contaminant mi-

gration exists. Plans for future studies to determine the sources and extent of surface and ground-water contamination were developed.

41387 **(AD-A—191025/6/XAB) Installation-Restoration Program. Phase 2. Confirmation/quantification. Stage 1. Air Force Plant 3, Tulsa, Oklahoma. Final report, 16 September 1985-31 May 1987.** (Ecology and Environment, Inc., Buffalo, NY (USA)). May 1987. 554p. NTIS, PC A24/MF A01.

Ecology and Environment, Inc., was retained by the USAFOEHL/TS to provide technical and analytical services in support of the Air Force Installation-Restoration Program (IRP). These services were applied to the Phase II, Stage 1, investigation at Air Force Plant 3, Tulsa Oklahoma. The investigation included records searches, geophysical studies, and sampling of surface and subsurface soils and groundwater. Samples were analyzed for various parameters including volatile organics, oil and grease, TOX, TOC, phenols, PCBs, and titanium. Results of the investigation indicated that past waste handling and disposal practices had caused various degrees of soil and groundwater contamination at six of the seven sites. Follow-up (Stages 2) work was recommended at five sites to better define the extent of contamination. One site was judged to require no follow-up action, and one site is recommended for Phase IV (remedial action) work.

41388 **(AD-A—191175/9/XAB) Installation Restoration Program Toxicology Guide. Volume 2.** (Little (Arthur D.), Inc., Cambridge, MA (USA)). May 1987. 570p. NTIS, PC A24/MF A01.

See also Volume 3, AD-A191 176.

One of the objectives of the U. S. Air Force Installation Restoration Program is to provide individuals responsible for the management and implementation of the Installation Restoration Program (IRP) with information to evaluate the health hazards associated with actual or potential contamination of drinking-water supplies. Each volume of the IRP Toxicology Guide outlines the environmental fate and effects, exposure pathways, toxicity, and sampling and analysis techniques for a selected list of chemical contaminants. The material provided is intended as an overview of key topic areas; no attempt was made to provide a comprehensive review. This Guide is not a technical report. Users are encouraged to read the Introduction of Volume 1 of the IRP Toxicology Guide before applying chemical-specific information. The 35 chemicals included in Volume 1 of the IRP Toxicology Guide resulted from an Occupational and Environmental Health Laboratory (OEHL) review of all IRP Phase II reports available in March 1984. The selected chemicals were detected in ground water as part of the Phase II effort. An additional 24 chemicals are included in Volume 2 of the IRP Toxicology Guide. Volume 3 of the Guide is in preparation. Volume 3 will include pesticides and POL (petroleum, oil and lubricant) products of interest of the USAF Medical Service.

41389 **(AD-A—191176/7/XAB) Installation Restoration Program Toxicology Guide. Volume 3.** (Little (Arthur D.), Inc., Cambridge, MA (USA)). Jun 1987. 562p. NTIS, PC A24/MF A01.

See also Volume 1, AD-A171 095.

One of the objectives of the U. S. Air Force Installation Restoration Program is to provide individuals responsible for the management and implementation of the Installation Restoration Program (IRP) with information of evaluate the health hazards associated with actual or potential contamination of drinking-water supplies. Each volume of the IRP Toxicology Guide outlines the environmental fate and effects, exposure pathways, toxicity, and sampling and analysis techniques for a selected list of chemical contaminants. The material provided is intended as an overview of key topic areas; no attempt was made to provide a comprehensive review. This Guide is not a technical report. Users are encouraged to read the Introduction of Volume 1 of the IRP Toxicology Guide before applying chemical-specific information. The 35 chemicals included in Volume 1 of the IRP Toxicology Guide resulted from an Occupational and Environmental Health Laboratory (OEHL) review of all IRP Phase II reports available in March 1984. The selected chemicals were detected in ground water as part of the Phase II effort. An additional 24 chemicals were included in Volume 2 of the IRP Toxicology Guide. Volume 3 of the Guide contains 14 compounds, pesticides and POL (petroleum, oil and lubricant) products of interest of the USAF Medical Service.

41390 **(PB—88-190806/XAB) Model approach for RCRA (Resource Conservation and Recovery Act) ground-water regulations.** Starks, T.H. (Nevada Univ., Las Vegas (USA)). 1988. 9p. NTIS, PC A02/MF A01.

Pub. in Chemometrics and Intelligent Laboratory Systems 3, 151-157(1988).

A model approach to the formulation of statistical decision procedures in the monitoring of ground water at hazardous waste sites is recommended. A random-effects model for ground water monitoring measurements is suggested. A statistical decision procedure based on the model is formulated and criticized. Some of the practical problems in developing satisfactory statistical decision procedures for groundwater monitoring are discussed.

41391 **(PB—88-191440/XAB) Pathogen risk-assessment feasibility study.** (Environmental Protection Agency, Cincinnati, OH (USA). Office of Environmental Criteria and Assessment). Mar 1988. 237p. (EPA—600/6-88/003). NTIS, PC A11/MF A01.

The report evaluates the practicality of formulating guidelines to assess the risk associated with exposure to pathogens in sludge. Risk assessment may be used to determine the likelihood that an environmental agent may cause human disease (that is, potential to cause human cancer or toxicity). On the assumption that the agent causes a particular disease, given current and projected exposure levels, a quantitative evaluation can be made on the magnitude of the likely impact of the agent on public health. In the report, the feasibility of performing a micro-biological risk assessment for pathogens in municipal waste-water sludge by various disposal options was evaluated.

41392 **(PB—88-864103/XAB) Hazardous-materials waste disposal. June 1985-May 1987 (Citations from the NTIS data base). Report for June 1985-May 1987.** (National Technical Information Service, Springfield, VA (USA)). May 1988. 155p. NTIS PC N01/MF N01.

This bibliography contains citations concerning the disposal of hazardous industrial and municipal wastes, chemical agents, and a variety of other dangerous substances. Topics include restoration operations, contamination-abatement studies, appropriate regulation and legislation, and remedial-response strategies. Considerable attention is given to waste-disposal sites at military installations and to incineration operations. Citations pertaining specifically to radioactive waste disposal are excluded. (This updated bibliography contains 297 citations, none of which are new entries to the previous edition.)

41393 **(PB—88-864111/XAB) Hazardous-materials waste disposal. June 1987-May 1988 (Citations from the NTIS data base). Report for June 1987-May 1988.** (National Technical Information Service, Springfield, VA (USA)). May 1988. 64p. NTIS PC N01/MF N01.

Supersedes PB—87-860920.

This bibliography contains citations concerning the disposal of hazardous industrial and municipal wastes, chemical agents, and a variety of other dangerous substances. Topics include restoration operations, contamination-abatement studies, appropriate regulation and legislation, and remedial-response strategies. Considerable attention is given to waste-disposal sites at military installations and to incineration operations. Citations pertaining specifically to radioactive waste disposal are excluded. (This updated bibliography contains 116 citations, all of which are new entries to the previous edition.)

53 ENVIRONMENTAL-SOCIAL ASPECTS OF ENERGY TECHNOLOGIES

5301 Social And Economic Studies

REFER ALSO TO CITATION(S) 39379, 39380

41394 **(IIES-pre—83-16) Saving the environment: From whom, for whom, and by whom? A critical American perspective.** Schnaiberg, A. (Wissenschaftszentrum Berlin fuer Sozialforschung gGmbH (WZB) (Germany, F.R.). Internationales Inst. fuer Umwelt und Gesellschaft). 1983. 32p. Wissenschaftszentrum Berlin fuer Sozialforschung g.G.m.b.H. (WZB) (Germany, F.R.). Internationales Inst. fuer Umwelt und Gesellschaft.

Late-environmentalist movement organizations and especially appropriate technology (AT) movements have explicitly introduced social equity elements in their analysis and programs. Among the major gaps in social programs are: (1) the lack of consideration of wage levels under AT production transformations, (2) the failure to consider a wealth policy as well as a wage policy, and (3) the problems of supporting state provision of public goods and services under AT programs. To these gaps, and their political ramifications, must be added the political burdens of (1) attitudes towards redistributive policies, (2) the uncertainty that increased industrial growth necessarily has socially significant costs, and that AT will necessarily have socially significant benefits, and (3) the concomitant responses of politically-active people towards such major uncertainties. These political realities especially underlie current support for 'reindustrialization' rather than for AT-like programs in the United States. (orig./HSCH)

5302 Assessment Of Energy Technologies

REFER ALSO TO CITATION(S) 39355, 39506, 39980, 40067, 41610

41395 **(ORNL—6450/R5) Environmental regulatory update table, May 1988.** Langston, M.E.; Nikbakht, A.; Salk, M.S. (Oak Ridge National Lab., TN (USA)). Jun 1988. Contract AC05-84OR21400. 125p. NTIS, PC A06/MF A01; 1; GPO Dep. Order Number DE88013331/JAW.

The Environmental Regulatory Update Table provides information on regulatory initiatives of interest to DOE operations and contractor staff with environmental management responsibilities. The table is updated each month with information from the Federal Register and other sources, including direct contact with regulatory agencies. Each table entry provides a chronological record of the rulemaking process for that initiative with an abstract and a projection of further action.

55 BIOMEDICAL SCIENCES, BASIC STUDIES

5501 Behavioral Biology

REFER ALSO TO CITATION(S) 41331

5502 Biochemistry

REFER ALSO TO CITATION(S) 39437, 39461, 39498, 39499, 39508, 40551, 40552, 41413, 41415, 41516, 41518, 41520, 41527, 41536, 41537, 41539, 41541, 41545, 41573, 41586, 41587

41396 **(CONF-880285—1) Simple and efficient production of hybrid oligomeric enzymes by allelic complementation: Subunit interactions of ribulose bisphosphate carboxylase/oxygenase.** Larimer, F.W.; Soper, T.S.; Mural, R.J.; Hartman, F.C. (Oak Ridge National Lab., TN (USA)). 1988. Contract AC05-84OR21400. 3p. NTIS, PC A02/MF A01;1; GPO Dep. Order Number DE88011406/JAW.

From Miami bio/technology winter symposium on advances in gene technology: protein engineering and production; Miami, FL, USA (6 Feb 1988).

The in vitro production of hybrid enzyme has been used to examine subunit interactions and the formation of shared active sites. Recently, we described a functional test of a shared active site of ribulose bisphosphate carboxylase/oxygenase by coexpression of engineered mutants. Unlike in vitro complementation methods, which require reversible dissociation and reassociation of proteins, in vivo allelic complementation utilizes physiological assembly processes. Here, we describe the use of compatible expression plasmids which should be of general utility for the production of hybrid enzymes. 8 refs., 1 fig.

41397 **(CONF-8702136—) Future databases for molecular biology: EMBL/NIH [European Molecular Biology Laboratory/National Institutes of Health] workshop.** (European Molecular Biology Lab., Heidelberg (Germany, F.R.); National Inst. of General Medical Sciences, Bethesda, MD (USA)). 1987. 107p. NTIS, PC A09/MF A01. Order Number DE88009047/JAW.

From EMBL/NIH workshop on future databases for molecular biology; Heidelberg, F.R. Germany (25 Feb 1987).

The next generation of biological databases was the subject of an international gathering which was held at EMBL in Heidelberg. Dramatic changes in the use of the databases, and anticipated explosive growth of the available data motivated this attempt to outline future requirements. Present databases, in particular the nucleotide sequence database maintained by the EMBL Data Library and GenBank, are already facing the challenges presented by this rapid evolution. Sequencing the human genome is within reach of emerging technology, and recent discussions have emphasized the need for improved methods for maintaining and processing the wealth of sequence and related information that would be generated by sequencing on that scale. The future research needs of biologists were discussed in conjunction with the developments in the technology of data storage, transmission and processing that might be expected to satisfy these needs. To support this, it was recommended that an international advisory committee be established. The committee, to be composed of experts from the fields of molecular biology and information sciences, will provide advice and guidance in this crucial stage in the development of the databases.

41398 (CONF-8703182—Summs., pp 15-17) **Studies on the molecular mechanism of nucleotide excision repair in human cells.** Friedberg, E.C. (Stanford Univ., CA (USA)). 1987. NTIS, PC A07/MF A01. Order Number DE88002817/JAW.

From Conference on cellular molecular aspects, radiation induced DNA damage and repair; Albuquerque, NM, USA (10 Mar 1987).

Studies in this laboratory have focused on attempts to define the mechanism of nucleotide excision repair of DNA in human cells, with a view to understanding the molecular pathogenesis of the disease XP. With the advent of recombinant DNA technology, they directed their efforts to the molecular cloning of human genes defective in XP, with a view to using the cloned genes to overexpress proteins of interest for biochemical investigations. Initial studies exploited the selectable phenotype of marked sensitivity to killing of XP group A cells by UV radiation and by other DNA damaging agents. However, except for a single report in 1982 there has been no reproducible demonstration of complementation of the UV sensitivity of XP cells by DNA-mediated transfection. The apparent difficulties associated with transfection of XP cells have been the subject of several recent studies. In view of the multiple problems associated with stable transfection of XP cells using total genomic DNA, they have embarked on an alternative strategy designed to facilitate the cloning of human XP genes. This strategy involves the transfer of single human chromosomes into XP cells and screening for this relatively high frequency event. The idea is to identify chromosomes on which particular XP genes reside and then to isolate non-complementing derivatives of these chromosomes so that highly enriched DNA pools containing genes of interest can be generated by employing one or more subtractive strategies.

41399 (CONF-8703182—Summs., pp 51-54) **Molecular analysis of mutations in mice.** Rinchik, E.M. (Oak Ridge National Lab., TN (USA)). 1987. NTIS, PC A07/MF A01. Order Number DE88002817/JAW.

From Conference on cellular molecular aspects, radiation induced DNA damage and repair; Albuquerque, NM, USA (10 Mar 1987).

Understanding the molecular nature of mutations and the mechanisms by which mutations are translated into specific (and often complex) phenotypes is a major goal of mammalian biology. Molecular genetic analysis of heritable mouse mutations constitutes a significant, experimentally malleable strategy for relating genomic DNA structure to genic expression and function in mammals. Radiation-induced germ-line mutations, many of which are deletions or chromosomal rearrangements, have assumed important roles in strategies for (1) identifying new genetic loci in specific regions of the genome, (2) obtaining molecular access to these regions, (3) developing detailed molecular maps within regions, and (4) analyzing, at a functional level, the role(s) played by specific segments of genomic DNA in normal development as well as the effect(s) of mutation on biologically significant processes and phenotypes.

41400 (DOE/ER/60394—1) **The molecular biology of environmental aromatic hydrocarbons: Progress report for the period January 1, 1986-May 1, 1988.** Weiss, S.B. (Chicago Univ., IL (USA)). May 1988. Contract FG02-86ER60394. 12p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88011698/JAW.

Duplex DNA oligomer constructs (32 base pairs) were prepared that contained a single benzo[a]pyrene(BP) adduct at a specific deoxyadenosine or deoxyguanosine site in either one or both strands. These constructs were inserted into M13 replicative form viral DNA, and the DNA from progeny virus generated by transfection of Escherichia coli was examined by sequence analysis at the site of oligomer insertion. With nonalkylated constructs, and with constructs containing ony one BP adduct, no sequence alterations were found in progeny viral DNAs. With constructs containing two BP adducts, one in each strand and closely spaced, some progeny DNAs showed the original oligomer sequence, whereas others exhibited large deletions and illegitimate (nonhomologous) recombination, both of which removed the damaged construct. Increasing the distance between BP adducts in the construct reduced the frequency of recombinant events. These sequence alterations occurred in both recA/sup plus/ and recA/sup minus/ host cells. We speculate that the closely spaced adducts in opposite construct strands cause a rare distortion in DNA structure which activates the recombinant machinery, and that mutagenic and carcinogenic agents other than polycyclic aromatic hydrocarbons may cause similar DNA distortions, which induce illegitimate recombination. Studies employing ultraviolet irradiation as the damaging agent for site-specific DNA constructs are currently in progress. Preliminary results tend to support the above speculation. These results indicate that uv-damaged constructs, containing a single TT dimer in each construct strand and used as inserts in the same viral DNA system as described for BPDE-damaged constructs, also induce large deletions and illegitimate recombination. 10 refs., 5 figs., 1 tab.

41401 (DOE/ER/60621—1) **Incision of uv irradiated DNA in yeast: Progress report, November 1, 1987-May 31, 1988.** Prakash, L. (Rochester Univ., NY (USA). School of Medicine and Dentistry). Jun 1988. Contract FG02-88ER60621. 3p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE88012461/JAW.

The objectives are to determine the details of the incision step of excision repair following exposure to UV light in the yeast Saccharomyces cerevisiae. The approach is to focus on three of the 10 genes involved in this process - RAD1, RAD3, and RAD10. The three proteins are purified from yeast cells carrying overproducing plasmids for the respective proteins RAD3 protein has already been purified to near homogeneity, and, as predicted from features in the nucleotide sequence, was found to possess single-stranded DNA-dependent ATPase activity. It also has DNA helicase action during excision repair and will test its implications. Further characterization of the RAD3 protein is in progress, including its interaction with yeast DNA polymerase. The RAD1 and RAD10 proteins are being purified from yeast and will be characterized for various biochemical properties. The human RAD10 homolog is also being studied. Defective DNA repair and enhanced neoplasia characterize several human genetic diseases, thus, thorough understanding of the molecular mechanisms of DNA repair may provide a better understanding of the causes of carcinogenesis. 3 refs.

41402 (INIS-mf—11774) **Substance P in human cerebrospinal fluid. Quantitative determination using a combined method of high-pressure liquid chromatography and RIA.** Wallasch, T.M. (Wuerzburg Univ. (Germany, F.R.). Medizinische Fakultaet). 26 Feb 1987. 207p. (In German). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88754171/JAW.

Using a combined method of reversed-phase, high-pressure liquid chromatography and RIA, the author was able to isolate the neuropephide substance P from human cerebrospinal fluid and to make a quantitative measurement. The rp-HPLC-RIA method was found to be superior to other methods. (MBC).

41403 (PB—88-865613/XAB) **Chemical and biological warfare: biochemistry, therapy, and treatment. January 1970-May 1988 (citations from the NTIS data base). Report for January 1970-May 1988.** (National Technical Information Service, Springfield, VA (USA)). Jun 1988. 110p. NTIS PC N01/MF N01.

This bibliography contains citations concerning biochemistry, therapy, and treatment of military chemical and biological warfare agents. References include surveys and studies of immunizing agents and drugs, the efficacy of these drugs, and the effect of the drugs on the patient. Included are biochemical studies, assay techniques, and antidote development, some of which is supported by animal studies. Other published searches in this series cover detection and warning, defoliants, protection, biology and toxicolgy, and general studies. (Contains 95 citations fully indexed and including a title list.)

41404 **mRNA-decapping enzyme from Saccharomyces cerevisiae: Purification and unique specificity for long RNA chains.** Stevens, A. (Biology Div., Oak Ridge National Lab., Oak Ridge, TN (US)). *Molecular and Cellular Biology;* 8: No. 5, 2005-2010(May 1988).

An enzyme that hydrolyzes one PP/sub i/ bond of the cap structure of mRNA, yielding m/sup 7/GDP and 5'-p RNA was purified from Saccharomyces cerevisiae to a stage suitable for characterization. The specificity of the enzyme was studied, using both yeast mRNA and synthetic RNAs labeled in the cap structure. A synthetic capped RNA (540 nucleotides) was not reduced in size, while as much as 80% was decapped. Yeast mRNA treated with high concentrations of RNase A, nuclease P1, or micrococcal nuclease was inactive as a substrate. The use of synthetic capped RNAs of different sizes (50 to 540 nucleotides) as substrates showed that the larger RNA can be a better substrate by as much as 10-fold. GpppG-RNA was hydrolyzed at a rate similar to that at which m/sup 7/GpppG-RNA was hydrolyzed. The PP/sub i/ bonds of an RNa containing a 5'-triphosphate end group were not hydrolyzed.

41405 **New sequencers to take on the genome.** *Science (Washington, D.C.);* **238**: No. 4825, 271-273(16 Oct 1987).

DOE is exploring technologies that may allow sequencing thousands of bases a second, for less than a penny a base. There is considerable skepticism about whether that rate can actually be attained anytime soon. At this stage, most efforts are focusing on working out the bugs for the first generation of automated DNA sequencers. Sequencing by conventional techniques, involves generating a series of DNA fragments that vary in length by one nucleotide base-that is, they start at the same point and end at different bases, an A, G, T, or C.

41406 **High-speed chromosome sorting.** Gray, J.W.; Dean, P.N.; Fuscoe, J.C.; Peters, D.C.; Trask, B.J.; van den Engh, G.J.; van Dilla, M.A. (Lawrence Livermore National Lab., CA (USA)). *Science (Washington, D.C.);* **238**: No. 4825, 323-329(16 Oct 1987). Contract W-7405-ENG-48.

Dual-beam high-speed sorting has been developed to facilitate purification of chromosomes based on DNA staining with the fluorescent dyes Hoechst 33258 and chromomycin A3. Approximately 200 chromosomes per second of two types can be sorted from a suspension of chromosome isolated from human lymphoblasts while fluorescent objects (chromosomes, debris fragments, chromosome clumps, and nuclei) are processed at the rate of about 20,000 per second. This sorting rate is approximately ten times that possible with conventional sorters. Chromosomes of a single type can be sorted with a purity of about 90 percent. DNA from the sorted chromosomes is suitable for construction of recombinant DNA libraries and for gene mapping.

41407 **In vitro models for mutagenesis: A role for lesion, polymerase and sequence.** Strauss, B.; Larson, K.; Rabkin, S.; Sagher, D.; Sahm, J.; Shenkar, R. (Dept. of Molecular Genetics and Cell Biology, The Univ. of Chicago, Chicago, IL 60637 (USA)). pp 149-160 of Genetic toxicology of environmental chemicals. Ramel, C.; Lambert, B.; Magnusson, J. New York, NY; Alan R. Liss Inc. (1986). (CONF-8506373—).

From Genetic toxicology of environmental chemicals, part A: basic principles and mechanisms of action; Stockholm, Sweden (24 Jun 1985).

The fidelity with which DNA polymerases replicate undamaged DNA and DNA with lesions which alter, but do not abolish base pairing, varies. Others have been able to systematize some of the factors which result in base substitution errors. The rate factors involve the addition of an incorrect base at a particular site, the proof reading excision of this base (by prokaryotic polymerases) and the rate of strand elongation, which "fixes" the mutation by making the base substitution resistant to editing exonuclease action. At least one additional factor needs to be added to the Fersht formulation. As will be demonstrated, the happenings at particular sites in the DNA depend in some way on the surrounding nucleotides, since the same base change has different effects at different locations.

41408 **In vivo competition studies with analogues of 3-quinuclidinyl benzilate.** Eckelman, W.C.; Grissom, M.; Conklin, J.; Rzeszotarski, W.J.; Gibson, R.E.; Francis, B.E.; Jagoda, E.M.; Eng, R.; Reba, R.C. (George Washington Univ. Medical Center, Washington, DC (USA)). *Journal of Pharmaceutical Sciences;* **73**: No. 4, 529-534(Apr 1984).

Among ligands that bind to the α- and β-adrenoceptors and to the muscarinic acetylcholine receptor (m-AChR), those that bind to the latter have the best properties for external detection of receptor sites by gamma-camera imaging. To develop the optimal radiotracer, nonradioactive analogues of 3-quinuclidinyl benzilate (I) were tested in vivo displacement studies with (-)-[^{3}H]I to determine their ability to compete with (-)-[^{3}H]I for the muscarinic acetylcholine receptor. There is a linear correlation between the ability to compete with (-)-[^{3}H]I for the m-AChR and the affinity constant of the analogue as determined by in vitro assay, suggesting that the test is a valid indicator of in vivo distribution. One radioiodinated analogue, 3-quinuclidinyl p-iodobenzilate, bound to m-AChR in the heart and brain of rats.

41409 **Relational database system for the maintenance and verification of the Los Alamos sequence library.** Kanehisa, M.; Fickett, J.W.; Goad, W.B. (Los Alamos National Lab., NM (USA)). *Nucleic Acids Research;* **12**: No. 1, 149-158(1984).

The nucleic acid sequence databases of Los Alamos National Laboratory, European Molecular Biology Laboratory, and others are organized in a single relational database. This organization with a suitable relational database management program facilitates the tasks of reporting statistics, making cross-references, and double-checking of the original databases.

41410 **Construction of a genomic library of Neurospora crassa.** Schablik, M.; Delange, A.M.; Shums, A.A.; Mishra, N.C. (Univ. of South Carolina, Columbia (USA)). *FEMS Microbiology Letters;* vp(1982). Contract AS09-78EV01071.

A simple method for the construction of a complete genomic library of Neurospora crassa is described here for the first time. The method described includes the preparation of a high-M/sub r/ fungal DNA (free of RNA) followed by its restriction and then ligation to plasmid DNA (pBR322) at the BamHI site. The treatment of the BamHI-digested plasmid DNA with the bacterial alkaline phosphatase (BAP) was found to prevent the recircularization of the plasmid DNA during the process of ligation by T4 ligase. Over 99% of the plasmid obtained after the BAP treatment were hybrid in nature and contained Neurospora DNA as inserts at the BamHI site. The hybrid plasmid Neurospora DNA insert (7-19 kb) were used to transform an antibiotic-sensitive strain of E. coli (JA221) to ampicillin-resistant one. Over 10,000 transformant colonies (resistant to ampicillin but sensitive to tetracycline) were obtained to represent the entire genome of N. crassa. The method described here is reproducible and quickly adaptable to other fungi of scientific and industrial importance.

41411 **Recognition of protein coding regions in DNA sequences.** Fickett, J.W. (Los Alamos National Lab., NM (USA)). *Nucleic Acids Research;* **10**: No. 17, 5303-5318(1982).

The authors give a test for protein coding regions which is based on simple and universal differences between protein-coding and noncoding DNA. The test is simple enough to use without a computer and is completely objective. The test has been thoroughly proven on 400,000 bases of sequence data: it misclassifies 5% of the regions tested and gives an answer of No Opinion one fifth of the time. They predict some new coding and noncoding regions in published sequences.

5503 Cytology

REFER ALSO TO CITATION(S) 41498, 41506

41412 **(CONF-8804150—1) Outlook for new bioassays for multistep carcinogenesis.** Griesemer, R.A. (Oak Ridge National Lab., TN (USA)). 1 Jun 1988. Contract AC05-84OR21400. 6p. NTIS, PC A02/MF A01;1; GPO Dep. Order Number DE88011839/JAW.

From Symposium on assessing the risks from toxics in the northern California environment: what science can tell us; San Francisco, CA, USA (7 Apr 1988).

Proposed here is an alternate approach to carcinogen bioassays that would provide ancillary information about the biological factors that lead to cancer. Carcinogenesis is discussed as a multistep process.

41413 **Cytosine arabinoside: molecular, pharmacokinetic and cytokinetic considerations.** Pallavicini, M.G. (Lawrence Livermore National Lab., CA (USA)). *Pharmacology and Therapeutics;* **25**: 207-238(1984). Contract W-7405-ENG-48.

The objective of this article is to review and collectively evaluate information obtained from several laboratories on various effects of Ara-C, including perturbations occurring at the molecular, biochemical, cellular and whole animal level. This review will focus on investigations of Ara-C effects in mammalian cell systems in vitro, and on murine tumors, small intestine and hematopoietic cells in vivo, and is by no means exhaustive with regards to the published literature. The extent to which these data, obtained for the most part following single drug exposure, can be used to provide a better understanding of the effects observed following multiple dose treatment will be discussed. In summarizing the current level of knowledge of the relationship of biochemical and molecular perturbations with cellular toxicity, in both murine tumor and normal systems, the areas in which additional information is required to facilitate design of optimal therapeutic schedules will become more apparent.

41414 **Stress relaxation of cell walls and the yield threshold for growth: demonstration and measurement by micropressure probe and psychrometer techniques.** Cosgrove, D.J.; Van Volkenburgh, E.; Cleland, R.E. (Pennsylvania State Univ., University Park (USA)). *Planta;* **162**: 46-54(1984). Contract AM06-70RL02225.

Theory predicts that, for growing plant cells isolated from a supply of water, stress relaxation of the cell wall should decrease cell turgor pressure (P) until the yield threshold for cell expansion is reached. This prediction was tested by direct P measurements of pea (Pisum sativum L.) stem cortical cells before and after excision of the growing region and isolation of the growing tissue from an external water supply. Cell P was measured with the micro-pressure probe under conditions which eliminated transpiration. Psychrometric measurements of water potential confirmed the pressure-probe measurements. Following excision, P of the growing cells decreased in 1 h by an average of 1.8 bar to a mean plateau value of 2.8 bar, and remained constant thereafter. Treatment with 10^{-5} M indole-3-acetic acid of 10^{-5} M fusicoccin (known growth stimulants) accelerated the rate of P relaxation, whereas various treatments which inhibit growth slowed down or completely stopped P relaxation in apical segments. In contrast, P of basal (nongrowing) segments gradually increased because of absorption of solutes from the cell-wall free space of the tissue. These results provide a new and rapid method for measuring the yield threshold and they show that P in intact growing pea stems exceeds the yield threshold by about 2 bar. Wall relaxation is shown here to affect the water potential and turgor pressure of excised growing segments.

5504 Genetics

REFER ALSO TO CITATION(S) 39499, 41397, 41401, 41474, 41479

41415 **(PB—88-162797) Mapping our genes: Federal Genome projects: How vast? How Fast?.** (Office of Technology Assessment (U.S. Congress), Washington, DC). 26 Jun 1987. 265p. (CONF-8706309—). NTIS, PC A12/MF A01. Order Number TI88011148/JAW.

From Workshop on issues of collaboration for human genome projects; Washington, DC, USA (26 Jun 1987).

This document provides the transcript of the discussion by panel members of legal land ethical issues confronting the biotechnology community. The meeting was convened at the request of the Congressional Office of Technology Assessment to help it prepare an assessment of the Human Genome Project. The issues discussed include patent rights, intellectual property rights, and the positions of the US National Institutes of Health, US Department of Energy, and US National Science Foundation with regard to these rights.

41416 **Butyrate-induced changes in nuclease sensitivity of chromatin cannot be correlated with transcriptional activation.** Birren, B.W.; Taplitz, S.J.; Herschman, H.R. (Div. of Biology, California Institute of Technology, Pasadena, CA 91125 (USA)). *Molecular and Cellular Biology;* 7: No. 11, 3863-3870(Nov 1987).

The authors examined in the H4IIE rat heptoma cell line the relationship between butyrate-induced changes in the nuclease sensitivity of chromatin and changes in transcriptional activity of specific genes. The butyrate-inducible metallothionein I (MT-I) gene underwent a dramatic increase in DNase I sensitivity after 3 h of butyrate treatment. However, genes not transcribed in H4IIE cells underwent the same changes in DNase I sensitivity. Thus, butyrate-induced increases in DNase I sensitivity are not sufficient for the transcriptional activation of a gene. Butyrate treatment has also been reported to alter the sensitivity of sequence to micrococcal nuclease (MNase) in a manner reflecting their tissue-specific expression. Butyrate exposure caused increased digestion of the MT-I gene by MNase. However, butyrate-induced MNase sensitivity also occurred for genes which are neither transcribed in untreated cells nor butyrate inducible. Moreover, cadmium, a potent transcriptional activator of the MT-I gene, does not alter the sensitivity of the MT-I gene to MNase. Thus, the butyrate-induced alterations in MNase sensitivity are neither sufficient for, necessary for, nor indicative of transcriptional activation.

41417 **Chromosome classification and purification using flow cytometry and sorting.** Gray, J.W.; Langlois, R.G. (Lawrence Livermore National Lab., Biomedical Sciences Div., Univ. of California, P.O. Box 5507, L-452, Livermore, CA 94550 (USA)). pp 195-236 of Annual review of biophysics and biophysical chemistry, Volume 15. Engelman, D.M. Palo Alto, CA; Annual Reviews Inc. (1986). Contract W-7405-ENG-48.

The authors review both the techniques and the applications of flow karyotyping and sorting, hereafter called flow cytogenetic. Included in their review of the techniques are the procedures for chromosome isolation and staining, the principles of flow cytometry and sorting, and the analytical procedures for classification of the chromosomes from flow cytometric data. Applications reviewed include classification of normal human chromosomes, identification of disease-linked structural and numerical aberrations, quantification of the frequency of structurally aberrant chromosomes as a measure of the extent of induced genetic damage, and purification of chromosomes of a single type to facilitate interpretation of flow karyotypes, gene mapping, and production of recombinant DNA libraries from chromosomes of a single type.

41418 **Molecular mechanisms of mutagenesis determined by recombinant DNA technology.** Lee, W.R. (Dept. of Zoology, Louisiana State Univ., Baton Rouge, LA (USA)). pp 423-432 of Genetic toxicology of environmental chemicals. Ramel, C.; Lambert, B.; Magnusson, J. New York, NY; Alan R. Liss Inc. (1986). (CONF-8506373—).

From Genetic toxicology of environmental chemicals, part A: basic principles and mechanisms of action; Stockholm, Sweden (24 Jun 1985).

Recent developments in recombinant DNA technology have profoundly altered our knowledge of the molecular structure of the eukaryote gene. Emphasis has ben placed on the use of recombinant DNA technology for synthesis of products; however, this paper will deal with the use of the new molecular techniques to complement existing classical genetic analysis for studying the molecular mechanisms of mutagenesis. There are three areas to which the author feels the new techniques should be directed: 1) mechanisms of mutagenesis, 2) comparative mutagensis, and 3) interpretation of results.

41419 **Construction and availability of human chromosome-specific gene libraries.** Fuscoe, J.C.; Van Dilla, M.A.; Deaven, L.L. (Lawrence Livermore National Lab., Biomedical Sciences Div., Livermore, CA 94550 (USA)). pp 465-474 of Genetic toxicology of environmental chemicals. Ramel, C.; Lambert, B.; Magnusson, J. New York, NY; Alan R. Liss Inc. (1986). (CONF-8506373—). Contract W-7405-ENG-48.

From Genetic toxicology of environmental chemicals, part A: basic principles and mechanisms of action; Stockholm, Sweden (24 Jun 1985).

The construction of human chromosome-specific gene libraries using flow- sorted chromosomes was initiated at the Los Alamos and Lawrence Livermore National Laboratories in 1983 primarily for two reasons: 1) both laboratories have excellent flow sorting instrumentation and years of experience in the use of sorted chromosomes for biological studies, and 2) both laboratories have received numerous requests over the past few years to provide purified chromosomes to investigators for their own research. The United States Department of Energy, our primary contractor, felt that the availability of chromosome specific libraries would have a major impact in studies of the human genome and that it would be more efficient to support the construction of these libraries for general distribution rather than purify chromosomes for each investigator. The authors agree with this assessment and have entered into a collaborative effort between the two laboratories.

41420 **Hematology of a murine β-thalassemia: A longitudinal study.** Popp, R.A.; Popp, D.M.; Johnson, F.M.; Skow, L.C.; Lewis, S.E. (Biology Div., Oak Ridge National Lab., Oak Ridge, TN 37831 (USA)). pp 432-444 of Fifth Cooley's anemia symposium. Bank, A.; Anderson, W.F.; Zaino, E.C. New York, NY; The New York Academy of Sciences (1985). (CONF-8405437—). Contract AC05-84OR21400.

From 5. Cooley's anemia symposium; New York, NY, USA (30 May 1984).

In 1972 an experiment was designed at the Oak Ridge National Laboratory with the primary goal of producing mouse models of human hemoglobinopathies. Three offspring in the study exhibited clinical symptoms of α-thalassemia; two of the three radiation-induced mutants were fertile and were propagated to produce stocks of α-thalassemic mice. A few years later, a chemically induced α-thalassemia mutation was discovered and propagated at the Jackson Laboratory. Each of the three heritable α-thalassemia mutations is associated with a deletion in mouse chromosome 11 that spans the embryonic x-globin and the two adult α-globin genes. Efforts to induce β-thalassemia mutations in mice by radiation and chemical mutagens were continued from 1976 through 1981, but no β-thalassemia mutation were recovered. In 1982 Dr. Susan E. Lewis discovered a spontaneous mutation at the β-gloin locus of a male DBA/2J mouse. A group of investigators from four laboratories joined together to analyze the genetic, molecular and clinical characteristics of this mutation. Murine β-thalassemia is inherited as a simple Mendelian trait. An absolute deficiency of the β/sup major/-globin polypeptide in the homozygous mutant is associated with a deletion of a 3.3-kilobase segment of DNA in mouse chromosome 7, which includes both the regulatory and coding sequences of the β/sup major/-globin gene. Mice homozygous for this mutation exhibit clinical symptoms of β-thalassemia whereas heterozygous β-thalassemic mice are clinically normal. This paper describes some of their studies on β-thalassemic mice through the first 14 months of their lives.

5505 Metabolism

REFER ALSO TO CITATION(S) 41506, 41557, 41598

41421 **(INIS-mf—11685) Molecular bases of the influence of calcium influx on the heart by means of a calcium duct-blocker.** Ruth, P. (Heidelberg Univ. (Germany, F.R.). Naturwissenschaftlich-Mathematische Gesamtfakultaet). 13 Dec 1985. 152p. (In German). NTIS (US Sales Only), PC A08/MF A01. Order Number DE88753797/JAW.

The goal of this work was to identify and purify the physiological binding places for calcium duct-blocker in the heart muscle of cattle. The following was thereby attempted: 1. to purify the plasma membranes from heart cells; 2. to develop a measuring method for the tension-dependent calcium duct with the help of tritiated calcium duct-blocker or respectively, to improve existing methods; 3. to characterize by the use of different calcium duct-blockers this ion duct; 4. to develop methods to solubilize the calcium duct out of the plasma membrane using detergents; as well as 5. to purify the dissolved calcium duct by use of various procedures such as affinity chromatography, chromatography on wheatgerm-agglutinin-substituted sepharose and density gradient centrifugation. (orig./MG)

41422 **(INIS-mf—11749) Release of peptides from Fibrinogen in vitro and in vivo.** Weibel, S. (Heidelberg Univ. (Germany, F.R.). Naturwissenschaftlich-Mathematische Gesamtfakultaet). 1986. 300p. (In German). NTIS (US Sales Only), PC A13/MF A01. Order Number DE88754022/JAW.

The dissertation deals experimentally with the following problem fields: The attempt was made to obtain extremely pure, native peptides from fibrinogen with micropreparation with the help of high-pressure liquid chromatography (HPLC); a HPLC-pure antigen which could be labelled (DAT-FPA) was also to be produced and a HPLC-purified, labelled antigen (J 125 DAT-FPA) for the radioimmunoassay was to be prepared. By applying HPLC-purified FPA-material to immunise rabbits, a highly specific antibody against FPA was obtained, and the radioimmunoassay was decisively improved. Furthermore, a method with a high recovery rate specific for the A-peptides could be found. A procedure was developed which is able to separate the modifications from the plasma from one another and to prove them specifically in ng-quantities. This is the first time that the sensitive method of high-pressure liquid chromatography is used to observe the effects of the snake venom enzymes on fibrinogen over a period of 20 hrs. The kinetics of intravenously administered J 123 DAT-FPA and, in comparison, J 123 FPB β 15-42 in vivo in rabbits with the help of a scintiscanning method, was investigated and the distribution in the organism and the ways of elimination were determined.

41423 **(INIS-mf—11754) Influence of the anabolic agent flavichromin on osteotomy healing. A comparison of quantitative determination of re-mineralisation by means of osteodensitometry with histological results from animal experiments.** Schargus, G. (Wuerzburg Univ. (Germany, F.R.). Medizinische Fakultaet). 21 Jul 1982. 93p. (In German). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88754165/JAW.

In this work it was attempted to attain a quicker consolidation of bone fragments in rabbits after they had undergone a lower jaw osteotomy and fragment fixation and had been treated with the usual osteosynthetic medications as well as doses of the anabolic agent flavichromin to stimulate bone healing. The healing progress of the first four post-operative weeks was clinically, radiologically, and also histologically assessed and it was also attempted to test the value of densitometrically studying the X-ray pictures as a quantitative measurement of the re-mineralisation of the fracture line. Although animal-specific studies do not allow themselves to be directly applied to humans, because the osteogenesis rates differ too greatly from humans and though further studies on dogs should be undertaken, in order to make a more conclusive statement, flavichromin because of its easy applicability should be considered for future use on humans, especially in cases with healing complications. In the healing of bone defects, flavichromin should be considered. (TRV).

41424 **Anaerobic and aerobic metabolism of diverse aromatic compounds by the photosynthetic bacterium Rhodopseudomonas palustris.** Harwood, C.S.; Gibson, J. (Cornell Univ., Ithaca, NY (USA)). *Applied and Environmental Microbiology;* **54**: No. 3, 712-717(Mar 1988). Contract FG02-86ER13495.

The purple nonsulfur photosynthetic bacterium Rhodopseudomonas palustris used diverse aromatic compounds for growth under anaerobic and aerobic conditions. Many phenolic, dihydroxylated, and methoxylated aromatic acids, as well as aromatic aldehydes and hydroaromatic acids, supported growth of strain CGA001 in both the presence and absence of oxygen. Some compounds were metabolized under only aerobic or under only anaerobic conditions. Two other strains, CGC023 and CGD052, had similar anaerobic substrate utilization patterns, but CGD052 was able to use a slightly larger number of compounds from growth. These results show that R. palustris is far more versatile in terms of aromatic degradation than had been previously demonstrated. A mutant (CGA033) blocked in aerobic aromatic metabolism remained wild type with respect to anaerobic degradative abilities, indicating that separate metabolic pathways mediate aerobic and anaerobic breakdown of diverse aromatics. Another mutant (CGA047) was unable to grow anaerobically on either benzoate or 4-hydroxybenzoate, and these compounds accumulated in growth media when cells were grown on more complex aromatic compounds. This indicates that R. palustris has two major anaerobic routes for aromatic ring fissions, one that passes through benzoate and one that passes through 4-hydroxybenzoate.

5506 Medicine

REFER ALSO TO CITATION(S) 39435, 40505, 40578, 41423, 41571, 41571, 42083, 42084

41425 (CNEA—479) Application of the glycocolate /sup 14/C breath test in the stydy of rosacea. Woscoff, A.; Wainer, S.; Gaon, D.; Pisarello de Troparevsky, M.L.; Arciprete, C.P.; Mitta, A.E.A. (Hospital Durand, Buenos Aires (Argentina); Farmasa S.A., Buenos Aires (Argentina); Comision Nacional de Energia Atomica, Buenos Aires (Argentina). Gerencia de Investigaciones). (Comision Nacional de Energia Atomica, Buenos Aires (Argentina)). 1987. 14p. (In Spanish). NTIS (US Sales Only), PC A03/MF A01 - Comision Nacional de Energia Atomica, Buenos Aires (AR). Order Number DE88703112/JAW.

Informe.

Small bowel bacterial contamination was determined in patients affected by rosacea normal or gastric hyposecretors. The Breath Test /sup 14/C was used with glycocolate /sup 14/C Na. The study was completed by determination of gastric acidity, Key test, Schilling test and d xilosa test with positive results. Metronidazol was administered to these patients, thus normalizing the small bowel contamination and, at the same time, improving the dermatological process. (M.E.L.).

41426 (DOE/ER/60418—3) Nuclear medicine and imaging research (instrumentation and quantitative methods of evaluation): Comprehensive 3-year progress report for the period January 15, 1986-January 14, 1989. Beck, R.N.; Cooper, M.D. (Franklin McLean Memorial Research Inst., Chicago, IL (USA)). Jun 1988. Contract FG02-86ER60418. 61p. NTIS, PC A04. Order Number DE88012970/JAW.

This program addresses the problems involving the basic science and technology underlying the physical and conceptual tools of radioactive tracer methodology as they relate to the measurement of structural and functional parameters of physiologic importance in health and disease. The principal tool is quantitative radionuclide imaging. The overall objective of this program is to further the development and transfer of radiotracer methodology from basic theory to routine clinical practice in order that individual patients and society as a whole will receive the maximum net benefit from the new knowledge gained. The focus of the research is on the development of new instruments and radiopharmaceuticals, and the evaluation of these through the phase of clinical feasibility. 58 refs., 15 figs., 4 tabs.

41427 (GAO/RCED—87-122) Nuclear regulation: Public knowledge of radiological emergency procedures. (General Accounting Office, Washington, DC (USA)). 1987. 14p. General Accounting Office, PO Box 6015, Gaithersburg, MD 20877.

GAO found that no federal agency assesses public knowledge of radiological emergency procedures. The Federal Emergency Management Agency has responsibility for ensuring the adequacy of offsite emergency plans at nuclear power plants and has periodically conducted surveys to determine whether emergency planning zones residents have received basic emergency planning information. However, FEMA has not assessed whether the public actually knows what to do in the event of an emergency. GAO believes it is appropriate that FEMA do this. This report provides information concerning the actions that utilities and FEMA take to notify EPZ residents of the procedures to be followed if a nuclear accident occurs. It recommends that FEMA develop a survey to assess EPZ residents' knowledge of radiological emergency procedures.

41428 (INIS-mf—11256) Scintigraphical analyses of pulmonary function in dogs. Clercx, C. (Rijksuniversiteit Utrecht (Netherlands)). 28 Jan 1988. 155p. NTIS (US Sales Only), PC A08/MF A01. Order Number DE88703267/JAW.

Contains summary in Dutch and one in French.

The main goal of this study was to develop a quantitative analysis from 99mTc aerosol inhalation/perfusion (I/P) lung scintigrams. In particular attention was focused on both the regional I/P distribution, concerning the ratio of the mean I and P values in several lung regions, as well as on the local (intraregional) distribution of I/P, under a wide range of circumstances. In Ch. 2, the method and reference material are described. The distribution of the inhalation-to-perfusion ratios (I/P) is studied in anesthetized healthy dogs, with emphasis on inter-regional distribution and intra-regional dispersion of the I/P ratio. Moreover, it provides an insight into canine pulmonary physiology, frequently transposed from human lung physiology, what is not always correct. Ch. 3 deals with the possible methodological and physiological influences on the interpretation of scintigraphical measurements, such as age, posture and breed. Investigation of the effects of age and breed was pursued using qualitative studies of canine lung surfactant. The actual knowledge in this field lets prospect veterinary clinical meaning in the future. Finally in Ch. 4, the diagnostic value of the measurements was examined in experimental models of important lung disorders with different pathophysiological features, such as lobar and sublobar airway obstruction, and lung embolism. It also permits the investigation of the relative contribution of different compensating mechanisms upon the ventilation-to-perfusion ratio, such as collateral ventilation and hypoxic vasoconstriction. 218 refs.; 31 figs.; 14 tabs.

41429 (INIS-mf—11691) On the relationship of cytoplasmic and nuclear /sup 3/H-estradiol bonding in human mammary carcinoma cells with special consideration of the sucrose density centrifugation in comparison to the charcoal method. Semm, D.M. (Marburg Univ. (Germany, F.R.). Fachbereich Humanmedizin). 18 Jun 1982. 96p. (In German). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88753799/JAW.

According to a hypothesis from Wittliff an estrogen-positive-receptor tumor would indicate the need for endrocrinological therapy if after sucrose density centrifugation on S-peak of 8-9 is found. In this work this hypothesis is studied, the sucrose density centrifugation is compared to the charcoal method, a normal value range is determined for the sucrose density centrifugation and the amount of cytoplasmic estrogen bonding is correlated with the estrogen chromatin bonding capacity. With malignantly degenerated breast cells the average /sup 3/H-estradiol bonding capacities for the charcoal method were 74.09 fmol/mg protein and respectively 22.9 fmol/mg protein with incubation in 2.5x10/sup -8/M /sup 3/H-estradiol. For the sucrose density centrifugation 42.81 fmol/mg protein was found as average value in the peak fraction (4-5 S-range). With the use of the charcoal method 78% of the carcinoma were estrogen-receptor positive compared to 57% using the sucrose density centrifugation (n=23). The average nucleus bonding amount in the case of 15 carcinomas which were studied for their estradiol chromatin bonding capacity was 588.1 dpm/1 μg DNA. Together with the estradiol receptor analysis the determination of nucleus bonding capacity appears to be a promising procedure especially for postclimacteric women for reducing the rate of non-responders. Beyond that this receptor combination could offer a contribution to the malignancy grading of nuclear mastopathy results procedure. Wittliff's hypothesis, a tumor is first estrogen sensitive when an 8-9 S-peak is present, could not be confirmed. Neither could the 8-9 S-peaks in the form given by Wittliff be reproduced nor could any positive correlation to cytoplasmic bonding or respectively to /sup 3/H-estradiol chromatin bonding be found. (orig.)

41430 (INIS-mf—11692) Rat TSH: Radioimmunological verification and secretion in vitro. Rief-Mohs, G. (Ulm Univ. (Germany, F.R.). Fakultaet fuer Theoretische Medizin). 18 Feb 1983. 73p. (In German). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88753800/JAW.

The rat TSH radioimmunoassay with ^{125}I was worked up and validated. Measurement area: 300-10^4 ng TSHml, lower detection limit 200 ngml, intra-assay variance 3-5%, inter-assay variance 11-18%. For the study of TSH secretion in dispersed anterior pituitary cells, these cells were subjected to an one-hour incubation with a changing TRH concentration. This system, however, did not prove to be sensitive enough for a TRH-in vitro-bioassay. A culture of vital, functioning cells in micro-titer plates up to 30 days was possible. After stimulation with 10^{-11} to 10^{-6} M TRH over 2 hours a linear dose-dependent increased secretion of TSH with a maximum TSH response of 300% was shown. After fractionation of the anterior pituitary cells after a sedimentation over an albumin gradi-

ent it was shown that after fraction 40 there was an increase in the TSH content with a massive increase in TSH cells around fraction 60. The TSH content lay here around the factor 200 above that of the original suspension. A culture of pure TSH cells is therefore possible and for further studies accessible. (orig.)

41431 **(INIS-mf—11693) Establishment of an indirect solid phase radioimmunoassay for the detection of HSV-type I-specific antibodies in human serum.** Buchow, H. (Freie Univ. Berlin (Germany, F.R.)). 6 Dec 1982. 63p. (In German). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88753801/JAW.

An indirect solid phase radioimmunoassay (IFRIA) was developed for the detection in human serum of antibodies against Herpes simplex virus (HSV) type I. The IFRIA was carried out according to the 'sandwich' principle. In comparison to other serological routine methods, especially the complement binding reaction (CBR) commonly used for HSV diagnostic, the IFRIA excelled by being a test which is quick to carry out and by lacking the subjectivity by the researcher in the evaluation of the test results, as well as by the use of patients serum which had not been previously treated. Comparative studies between IFRIA and CBR resulted in no agreement between the respectively attained maximum titer. As a reason for this the different qualities of the antibodies which can be determined by each test were discussed. For the addition of this test to the routine diagnostic further studies in the preservation of the specificity of the antigen in the case of longer storage are requisite. (orig.)

41432 **(INIS-mf—11694) Image of a brain stroke in a computed tomograph. The correlation of computed tomographical results with the predilection types of stroke.** Just, E.G. (Koeln Univ. (Germany, F.R.). Medizinische Fakultaet). 26 Nov 1982. 92p. (In German). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88753802/JAW.

On the basis of 100 findings from patients who suffered brain strokes and by the use of 1500 ensured stroke images it was tested whether or not the stroke-predilection typologie outlined by Zuelch is based on a coincidental summation of individual cases. The radiocomputed tomography with the possibility of evaluation of nonlethal cases proved itself as a suited method for confirmation or repudiation of this stroke theory. By means of the consistently achieved association of the frontal, respectively horizontal sectional image for the typology it could be proven and - with the exception of a few rather seldom types - also demonstrated that the basic and predilection types of brain stroke repeated themselves in their pattern. In individual cases a specification of lower types could also be undertaken. (orig./TRV)

41433 **(INIS-mf—11695) Results of radiosynoviorthesis with yttrium 90 in cases of chronic synovitis.** Schuette, H. (Duesseldorf Univ. (Germany, F.R.). Medizinische Fakultaet). 1982. 172p. (In German). NTIS (US Sales Only), PC A08/MF A01. Order Number DE88753803/JAW.

The goal of this study was to answer the following questions: Is the outcome of radiosynoviorthesis with ^{90}Y in patients who suffer from a chronic polyarthritis dependent on the stage according to Steinbrocker and does this dependency change when the results are measured 12 to 3 years later? Is there a difference between the effect of ^{90}Y on the joints of seropositive and seronegative patients? How are the results of radiosynoviorthesis in patients who suffer under other chronic joint diseases? What is the success distribution of re-synoviorthesis in evaluated patients? Is there a difference in the effectiveness of radiosynoviorthesis between joints in stage I and stage II and is the outcome dependent on whether or not degenerative changes are already present? Is the effect of radiosynoviorthesis, measured after one year, dependent on the duration of the disease in the treated joint or on the process activity of the disease? Is there a connection between the outcome of radiosynoviorthesis and the laboratory parameters of blood sedimentation and hemoglobin content? Does radiosynoviorthesis influence the number of medically induced, intra-articular injections and punctures in the treated joint? Is there a connection between radiosynoviorthesis outcomes and common therapy outcomes? What side effects of radiosynoviorthesis therapy were observed? (orig.MG)

41434 **(INIS-mf—11703) Limited angle problem in computerized tomography.** Louis, A.K. (Kaiserslautern Univ. (Germany, F.R.). Fachbereich Mathematik). Feb 1984. 17p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88754014/JAW.

Berichte der Arbeitsgruppe Technomathematik, Universitaet Kaiserslautern. Forschung - Ausbildung - Weiterbildung.; No. 5.

Fast reconstruction formulae in X-ray computerized tomography demand the directions, in which the measurements are taken, to be equally distributed over the whole circle. In many applications data can only be provided in a restricted range. Here the intrinsic difficulties are studied by giving a singular value decomposition of the Radon transform in a restricted range. Practical limitations are deduced.

41435 **(INIS-mf—11705) Contribution to the radiotherapy of collum and corpus carcinoma (Marburg results 1960-1979).** Kleinsorge, F. (Marburg Univ. (Germany, F.R.). Fachbereich Humanmedizin). 26 Mar 1982. 152p. (In German). NTIS (US Sales Only), PC A08/MF A01. Order Number DE88753807/JAW.

The subject of this work is the therapeutic success of radiation therapy, respectively operation, with uterine carcinoma. For the evaluation 938 patients of the Marburg University Radiation Clinic from the years 1960 to 1979 were included. The 5-year survival rate with collum carcinoma was 56.99% (stage I 79.62%, II 57.29%, III 31.13%, IV 5.88%). With patients with corpus carcinoma the 5-year survival rate was 74.27% (stage II 80.79%, I 77.50%, III 57.50%, IV 30.00%). The results of various radiotherapeutic methods ('Duesseldorf method', 'Marburg method') were discussed. With respect to the international results published in 'Annual Report' the Marburg results for the treatment of collum carcinoma (the 5-year survival rates) are at world level, and the successes in the treatment of corpus carcinoma are clearly better. (TRV)

41436 **(INIS-mf—11708) Value of standard radiology, angiography and computed tomography for the diagnosis of primary and secondary bone tumors.** Wagner, R. (Technische Univ. Muenchen (Germany, F.R.). Fakultaet fuer Medizin). 14 May 1986. 104p. (In German). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88753809/JAW.

The diagnostic value of X-ray images, angiography and computed tomography (CT) was compared using 45 benign, semi-malignant and malignant bone tumors. All around, computed tomography proved to be more accurate than angiography. CT is therefore recommended for use as the first non-invasive examination method after X-ray images have been made. (MBC)

41437 **(INIS-mf—11709) Comparison of standard radiological examinations, computed tomography, scintigraphy and angiography in the recidivistic diagnostic of bone tumors.** Schaeffer, G. (Technische Univ. Muenchen (Germany, F.R.). Fakultaet fuer Medizin). 14 May 1986. 126p. (In German). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88753810/JAW.

In a retrospective study the diagnostic efficiency of standard radiography, computed tomography (CT), bone scintigraphy and angiography in the diagnosis of tumor recidivism was studied using 54 patients with an operatively treated bone tumor. The highest diagnostic sensitivity (100%) was achieved with the help of CT. For the determination or exclusion of a recidivistic bone tumor, the diagnostic strength of the individual procedures lies in their combinations, but these combinations should be made on the basis of the tumor type and disease. (MBC)

41438 **(INIS-mf—11710) Studies on ^{192}Ir afterloading irradiation of the canine prostate with special consideration of thermoluminescent dosimetry.** Reuter, M. (Muenchen Univ. (Germany, F.R.). Fachbereich Tiermedizin). 25 Jul 1986. 91p. (In German). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88753811/JAW.

A method for high dose rate afterloading irradiation of the prostate with iridium 192 was developed. The isodoses of the urethra and rectum, which were measured by means of thermoluminescent dosimetry, showed deviations from the doses pre-calcu-

lated by computer (BRACHY), because this calculation is based on an anatomically ideal condition. (MBC)

41439 **(INIS-mf—11711) Clinical and radiological follow-ups on onlays and overlays from student courses.** Amann, W. (Tuebingen Univ. (Germany, F.R.). Medizinische Fakultaet). 1982. 73p. (In German). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88753812/JAW.

45 patients, whose teeth had been given onlays/overlays in student courses, were followed-up. The following values were measured: plaque index, sulcus bleeding index, clinical depth of the sulcus and the clinical findings for D (decayed) according to the DMF index for the maintained surfaces as well as for the control surfaces; beyond this eye tooth contact in lateral protrusion, lack of contact, approximal contact and approximal spatial orientation were evaluated. Bite wing pictures were taken and evaluated for the comprehension of iatrogenic marginal imperfections, for the control of the dentine in the area of the cervical edge of the filling and for the evaluation of the control surfaces. The maintained approximal surfaces were divided according to the degree of marginal imperfection into four imperfection groups. The data which were collected into a study list were evaluated statistically. (TRV)

41440 **(INIS-mf—11734) Studies on image quality and dose exposure in chest radiography in children.** Schumacher, R. (Giessen Univ. (Germany, F.R.). Fachbereich Humanmedizin). 1985. 109p. (In German). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88753815/JAW.

Chest radiography accounts for almost 50% of all radiographies in radiological departments for children, thus clearly dominating X-ray performances. The indications for examination in children are frequent infections of the upper airways, congenital cardiac defects, and controls in oncological patients. By contrast, indications for radioscopy of the chest organs which figure greatly in adult age and are often required concurrently with every chest radiography, are rather rare in the patient group of a paediatric X-ray department with their rate of c. 0.5% related to chest radiography. Chest radiographs and phantom radiographs were produced using different techniques and were compared by means of subjective and objective image quality parameters. Concurrently, thermoluminescence dosimetry was used to perform dose measurements of the small gonadal dose occurring in patients in chest radiographies. The study aimed at finding a chest radiography technique appropriate for use in paediatric radiology while considering both image quality parameters and the radiation dose required for producing pictures. (orig./DG)

41441 **(INIS-mf—11742) Radiological appearance from 250 patients of the Clinic and Policlinic for Radiology at the University of Munich with histologically detected bronchial carcinoma.** Bruckmayer, G. (Muenchen Univ. (Germany, F.R.). Fakultaet fuer Medizin). 15 Jul 1982. 141p. (In German). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88754162/JAW.

From 250 patients of the Clinic and Policlinic for Radiology at the University of Munich from 1975 to 1979 the radiomorphology of the central and peripheral bronchial carcinoma is demonstrated. The sex ratio of 6.3/1, the age distribution with its peak between 60 and 70 years of age and the localisations with a predominance in the right lung and a preferred infection of the upper lobes from our study agreed with the results from the literature. Characteristic early symptoms are missing with bronchial carcinoma, although clinical symptoms in the rule are the first evidence. For early recognition the first and easiest diagnostic procedure is the radiological examination of the thorax in two planes. Circular foci and peripheral tumor shadows, which occur with the spreading of the mediastinum or the hilus, in these patients about 50%, are in large amounts suspicious of a malignancy and indicate an advanced stage. Because the prognosis of the bronchial carcinoma depends on the histological structure of the tumor and on the point in time of diagnosis, an improvement of the life expectancy can only be reached by early detection. In the risk group of smokers over 40 years of age and of professionally exposed people, even minor changes should be considered as carcinoma until the opposite can be proven. (orig./TRV).

41442 **(INIS-mf—11743) Studies for the establishment of a radioimmunoassay for the detection of rubella-specific antibodies in human serum.** Buchow, B. (Freie Univ. Berlin (Germany, F.R.). Fachbereich Zahn-, Mund- und Kieferheilkunde). 10 Nov 1982. 66p. (In German). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88754163/JAW.

Studies were undertaken for the development of a solid-phase radioimmunoassay (RIA) for the recognition of rubella-specific antibodies in human serum. For this a rubella antigen, which can be found on the market for routine serological diagnostics and which is used for the hemagglutinin inhibition test (HAH; Behringwerke, Marburg), was used directly as an antigen in the RIA. A 'direct' RIA was run to establish a competition test as well as an 'indirect' RIA using the sandwich technique. A differentiation between antibody-positive and antibody-free patient serum could not be attained either by the direct or indirect RIA. The reason lay with the unsuitability of the rubella antigen used for the RIA. It is discussed, that the composition of the antigen from the supernatant of rubella-infected cell cultures and foreign protein is responsible for the non-specificity of the antibody bondings. (orig./TRV).

41443 **(INIS-mf—11744) Computed tomography of the liver and the biliary system. The diagnostic strength of studies using a 2.5 min. scanner.** Brall, B. (Muenchen Univ. (Germany, F.R.). Fakultaet fuer Medizin). 24 Jun 1982. 92p. (In German). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88754164/JAW.

The goal of this work was on the basis of bioptic controls to test the diagnostic strength of computed tomographic examinations which were carried out between 1976 and 1978 using a slow scanner (2,5 min.) relating to localized and diffuse liver diseases and diseases of the biliary tract. With the presentation at the same time of scintigraphic and/or sonographic findings, these were also bioptically controlled and the diagnostic strengths of all three non-invasive examination methods were compared. With localized liver diseases (n=323) CT had a specificity of 85%, a sensitivity of 81% and an accuracy of 84%. The total correct diagnoses by diffuse liver diseases (n=265) was 65%. In the differential diagnostis of icterus CT had a specificity of 100%, a sensitivity of 77%, and an accuracy of 83%. In the diagnosis of gall stones (n=19) CT only had a mediocre diagnostic strength. CT, liver scintigraphy and sonography in the case of localized liver diseases agreed roughly in reference to sensitivity, specificity and accuracy. CT proved itself to be superior to the other non-invasive procedures in the number of correct type diagnoses. CT and sonography were superior in diffuse liver diseases (n=173). The study showed the high diagnostic strength of CT with regard to the detection or exclusion of localized liver diseases and their type-diagnostic classification and the high reliability of the method with regard to the differential diagnosis of icterus. (orig./TRV).

41444 **(INIS-mf—11745) Comparative study for the echo cardiographic, radiologic and electrocardiographic presentation of the sport heart hypertrophy.** Reinke, A. (Deutsche Sporthochschule, Koeln (Germany, F.R.)). 1982. 194p. (In German). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88754018/JAW.

In this work the three most important non-invasive methods - X-ray pictures, electrocardiography and echo cardiography - were compared as to their ability to evaluate the physiological heart enlargement as a result of physical training. Important also was the study of the value of ultrasonic cardiographs. The subjects used were 162 athletes, 36 patients with cardiovascular diseases, and 22 non-athletic control persons. Radiologically the changes in the total size of the heart were determined. For the question of the adapting reaction of the heart because of athletic training the weight-related heart volume is more meaningful than the absolute value. Electrocardiographically it is not possible to come up with any statistically significant statements about the physiological heart enlargement using the Sokoloff-Lyon indexes. Echo cardiographically the regulative heart enlargements can be differentiated into myocardial hypertrophy or ventricular dilation. As a result of this a line can be drawn between physiological and pathological changes. Female athletes show qualitatively, but not quantitatively, the same adapt-

ing reaction. The synopsis of the three procedures shows that echo cardiography and radiology show better results than does electrocardiography. Together the methods complement each other in their diagnostic power. (orig./TRV).

41445 **(INIS-mf—11750) Bone scintigraphy as a process control with hemi-alloarthroplasty of the hip joint.** Shaltout, E.E.D. (Freie Univ. Berlin (Germany, F.R.)). 26 Jul 1983. 112p. (In German). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88753817/JAW.

For the diagnostic of prosthesis complications in the treatment of femur fractures near the hip joint ('intermediate prostheses') 216 skeletal scintigrams with 99mTc MDP were made of 143 patients from 1977 to 1982, partially retrospective and partially prospective. The evaluation of the photoscan was achieved visually and photodensitometrically and divided into 10 intensity levels with the following results: 1. Increased activity concentration in the acetabulum is pathological (activated arthrosis); 2. Increased activity concentration-temporary or also continuous - in the trochanter region is pathological (loosening process); 3. Non-pathological metabolic activity as a result of the bone healing process may last longer than 1 year postoperatively; 4. Heterotopic ossification, nonfixed bone fragments and pseudoarthrosis cause continuous or newly appearing concentrations; 5. Skeletal scintigraphy is an important supplement to radiological diagnostic and a sensitive method for the recognition of metabolic activities in bone. It is recommended for progress control after hemi-alloarthrosculpture of the hip joint. (orig./TRV)

41446 **(INIS-mf—11755) Indication of endocrine therapy from the radiological view with mammary carcinoma.** Nadji-Esfahani, A. (Technische Hochschule Aachen (Germany, F.R.). Medizinische Fakultaet). 15 Apr 1982. 178p. (In German). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88754166/JAW.

Important for the determining of the indication of endocrine treatment with mammary carcinoma is the pre-determination of receptors. A safe method for the choice of patients, for whom endocrine therapy would be appropriate, is not yet available. Patients who have no estrogen receptors, have as good as no chance, to be picked for endocrine therapy. The highest remission rates (around 60%) with endocrine therapy are attained when estrogen and progesterone receptors are both present, which, however, is usually only so in about one-third of the cases. Estrogen receptors are present in about 60 to 70% of the cases. With pre-menopausal women the following would be considered as endocrine procedures after switching off the ovaries: Androgens with abdominal, lung and pleura metastases; anti-estrogens (at best Tamoxifen) with abdominal and visceral metastasis; adrenalectomy with abdominal and bone metastases; and hypophyseal switching-off mostly with skeletal pains. In post-menopause estrogens are the first choice. In combination with progestogen they are indicated for abdominal and lung metastases and for carcinomatic pleura discharges. With abdominal and visceral metastasis Tamoxifen can be considered as first choice. The indications for hypophyseal switching-off, adrenalectomy and androgens are the same as for pre-menopausal women. (TRV).

41447 **(INIS-mf—11768) Novel amino-carboxy-dihydroboranes for neutron capture therapy.** Boehmel, T. (Technische Hochschule Aachen (Germany, F.R.). Mathematisch-Naturwissenschaftliche Fakultaet). 28 May 1985. 118p. (In German). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88754169/JAW.

The thesis discusses the following topics: I. Synthesis of boron compounds for the neutron capture therapy which are to meet the following requirements: 1. Low toxicity; 2. High boron content; 3. High enrichment and long retention time in the neoplastic tissue and simultaneous low concentration in blood and normal tissue; 4. Independent cytostatic effects; 5. Functional groups which allow a connection with polymers. II. Presentation of compounds with increased /sup 10/B content. III. Examination of the distribution of boric substances in living organisms by means of a quantitative analysis of the boron content.

41448 **(INIS-mf—11769) Radiological studies on Egyptian mummies. A contribution to modern mummy research with consideration of egyptological and medical historical aspects.** Pahl, W.M. (Tuebingen Univ. (Germany, F.R.). Medizinische Fakultaet). 1982. 223p. (In German). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88754170/JAW.

The goal of this work as part of a mummy study project is to obtain the maximum amount of information through radiological methods with the minimum destruction of the object. For this proven radiological methods were used as well as conventional radiological methods which had not yet been used with mummy research and modern radiological methods using an electronic basis relative to their importance for the study of medical archaeological materials. It is shown that the knowledge which is gained from the use of a combination of classical radiological methods and computed tomography cannot be enhanced by an autopsy of the study objects. Since because of this the objects can be kept in their original condition, a later checking of the results is guaranteed with the possibility of clearing up remaining open questions by means of further developed methods.

41449 **(INIS-mf—11775) Elimination of the thyroid of the rat by means of 131-I and verification of suitable control measures.** Hanauer, G. (Giessen Univ. (Germany, F.R.). Fachbereich Veterinaermedizin und Tierzucht). 15 May 1987. 140p. (In German). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88754172/JAW.

Carrier-free iodine-131 was used for thyroidectomy and injected intraperitoneally once or twice in a interval of 7 days. In five examinations iodine-131 was injected twice in an activity of 0.5 mCi, 0.4 mCi, 0.3 mCi, and 0.1 mCi or once in an activity of 1.0 mCi, 0.5 mCi and 0.4 mCi. The results yielded, that the thyroid gland can not be eliminated suitably with activities under twice 0.5 mCi iodine-131. An injection of once 1.0 mCi iodine-131 yielded at least to the same results, or reasons of ray hygiene single injection has to be preferred. As in vitro method only the measurement of the radioiodine incorporation in the exstirpated larynx with the gammacounter was qualified for the proof of residual thyroid tissue. Unfortunately the animals have to be sacrified and a topographic coordination of the results is impossible. Furthermore the thyroid status of one single animal can not be estimated when an control group is missing.

41450 (LBL—22962, pp 5-17) **Scientific rationale for the European Light Ion Medical Accelerator Project (EULIMA).** Fowler, J.F. (Mount Vernon Hospital, Northwood, Middlesex (England)). Apr 1987. NTIS, PC A11/MF A01. (CONF-861271—).

From 5. Particle Therapy Cooperative Group (PTCOG) meeting and international workshop on biomedical accelerators; Berkeley, CA, USA (1 Dec 1986).

The authors discuss the need for more clinical research facilities for light ion radiotherapy. The good results at Berkeley fully justify other centres to investigate this modality. There does not seem to be such a need for further neutron radiotherapy centres, provided that the existing high-energy neutron beams continue. The need for proton radiotherapy centres also exists, but there are radiobiological advantages associated with the heavier charged particle beams, in addition to the good dose localization which proton beams provide. Whether these radiobiological advantages will be worth the higher capital cost of ions heavier than protons can only be settled by the results of clinical trials. The difference in costs diminishes when the cost of the medical facilities and the long-term follow-up of cancer patients is taken into account. The author first discuss the radiobiological factors involved in high LET radiotherapy. Then they look at results from neutron therapy to see whether there are indications that high LET radiation per se, without advantages in terms of physical dose distributions, might provide radiobiological advantages.

41451 (LBL—22962, pp 19-41) **Some physical and biological properties of light ions.** Blakely, E.A.; Tobias, C.A.; Ludewigt, B.A.; Chu, W.T. Apr 1987. NTIS, PC A11/MF A01. (CONF-861271—).

From 5. Particle Therapy Cooperative Group (PTCOG) meeting and international workshop on biomedical accelerators; Berkeley, CA, USA (1 Dec 1986).

In this communication the term light ions is used for accelerated atomic nuclei that have a charge less than or equal to 10, whereas nuclei with atomic numbers greater than 10 are referred to as heavy ions. The principles used for building proton or helium synchrotrons are essentially the same as those required for accelerating other light ions. For the last several years at the Berkeley Bevalac a variety of biological and medical studies have been conducted with helium, carbon, oxygen and neon ions. In the course of these studies it has become apparent that light ions with atomic numbers of 6-10 have some advantages when compared to protons or helium. In this paper the authors concentrate on the radiobiological advantages in using extended Bragg peaks of light ions for beam localization; and the physical advantages of using light-ion beams for the production of small, accurately-placed lesions. They also discuss other areas of research including the desirability of having radioactive beams; and the special dose-rate effects due to the pulse structure of synchrotron beams.

41452 (LBL—22962, pp 43-46) **Particle therapy planning.** Zink, S. (National Cancer Institute, Bethesda, MD (USA)). Apr 1987. NTIS, PC A11/MF A01. (CONF-861271—).

From 5. Particle Therapy Cooperative Group (PTCOG) meeting and international workshop on biomedical accelerators; Berkeley, CA, USA (1 Dec 1986).

The Radiation Research Program (RRP) supports a variety of research through grants and contracts. During the last few years, considerable effort has been devoted to treatment planning evaluation in particle, photon and electron radiotherapy. In 1981, RRP issued a request for proposals (RFP) for the evaluation of treatment planning with particle beam radiotherapy - to include protons, heavy ions and neutrons. Contracts were subsequently awarded to four institutions: Massachusetts General Hospital (MGH), University of Texas and M.D. Anderson Hospital (MDAH), the heavy ion project at Lawrence Berkeley Laboratory (LBL) and University of Pennsylvania (UPa). These contracts reached completion December 31, 1986. The work for the contracts was carried out at the individual institutions and guided through a Working Group made up of the Project Officer and Principal Investigators and primary physicians and physicists at each of the participating institutions. This report summarizes the findings of the Working Group and makes recommendations for further research.

41453 (LBL—22962, pp 47-49) **What is needed to plan therapy with heavy charged particles.** Goitein, M. (Massachusetts General Hospital, Boston (USA)). Apr 1987. NTIS, PC A11/MF A01. (CONF-861271—).

From 5. Particle Therapy Cooperative Group (PTCOG) meeting and international workshop on biomedical accelerators; Berkeley, CA, USA (1 Dec 1986).

The almost uniform experience with radiotherapy using protons (and other heavy charged particles) is that both the planning and delivery of treatments is far more labor-intensive and time-consuming than for radiotherapy with conventional radiations - or, for that matter, than for neutron therapy. The differences arise from their different physical properties which include their finite penetration in tissue, Bragg peak, and low multiple scattering. These lead to the great advantage that one can tailor treatment volume to target volume. However the dose distributions are very sensitive to inhomogeneities.

41454 (LBL—22962, pp 51-58) **Treatment plan optimization.** Lyman, J.T. Apr 1987. NTIS, PC A11/MF A01. (CONF-861271—).

From 5. Particle Therapy Cooperative Group (PTCOG) meeting and international workshop on biomedical accelerators; Berkeley, CA, USA (1 Dec 1986).

A goal of radiation therapy is improve and prolong survival by control of local and regional tumor spread with as few side effects as possible. Treatment plan optimization is one of the methods used to achieve this goal. There can be many steps involved in treatment plan optimization which may involve interactions between the therapist, the physicists, the dosimetrist and the technologist. The simplest subdivision of treatment plan optimization is a division into two classes. These classes are clinical optimization and physical optimization. Under this division, clinical optimization is the; selection of modality, selection of fractionation scheme, localization of tumor, assessment of tumor spread, determination of tumor dose, determination of tolerance dose of critical structures, and development of an idealized dose distribution. Physical optimization is the process which leads to a treatment plan which best approximates the idealized dose distribution consistent with the limitations imposed by the available facilities. Probabilistic/biological approaches have been proceeding with a parallel development to the physical/geometric approaches. The complication probability factor (CPF) is a variant of an integral dose score of the physical/geometric approach. A limitation of the CPF is that it assumes that all normal tissue to be of a uniform composition and that the complication probability is linearly dependent on volume. A different approach to the probabilistic/biologic schemes has been developed at the Lawrence Berkeley Laboratory (LBL). This method directly addresses the stated therapeutic goal of controlling the tumor with a few side effect as possible. This probabilistic method is based on estimates of the probability of local control and the probabilities of being complication-free for each of the selected normal tissues. This method requires the dose distribution of the entire treated volume.

41455 (LBL—22962, pp 63-72) **230 MeV AVF Cyclotron dedicated to proton therapy at Tsukuba.** Takayama, T.; Takahashi, N. (Sumitomo Heavy Industries, Ltd., Kanagawa (Japan)). Apr 1987. NTIS, PC A11/MF A01. (CONF-861271—).

From 5. Particle Therapy Cooperative Group (PTCOG) meeting and international workshop on biomedical accelerators; Berkeley, CA, USA (1 Dec 1986).

A conceptual design study has been carried out for the 230 MeV cyclotron dedicated to proton therapy at the University of Tsukuba. This cyclotron is a fixed-field and fixed-frequency machine. The magnet has four sectors, and the rf system consists of two 90° dees operated in a fundamental push-pull mode. The proton source is a conventional source which is inserted from the vertical direction at the axis. The proton beams are extracted by using the 4/4 integer resonance.

41456 (LBL—22962, pp 73-91) **Current heavy particle medical accelerator programs in Japan.** Kawachi, K. (National Institute of Radiological Sciences, Chiba-shi (Japan)). Apr 1987. NTIS, PC A11/MF A01. (CONF-861271—).

From 5. Particle Therapy Cooperative Group (PTCOG) meeting and international workshop on biomedical accelerators; Berkeley, CA, USA (1 Dec 1986).

The first clinical trial of proton radiotherapy in Japan started at National Institute of Radiological Sciences (NIRS) in 1979. The proton which is provided from the NIRS medical cyclotron, has an energy of 70 MeV, and has been used for only superficial or short range tumor therapy. Recently, the cyclotron has been raised the energy up to 90 MeV and a vertical treatment line of protons has been completed in the basement of the cyclotron building. In 1983, Particle Radiation Medical Science Center (PARMS) of the University of Tsukuba started to treat patients with 250 MeV proton beam. The Institute of Physical and Chemical Research (IPCR) has a plan to construct a heavy ion biomedical irradiation facility in the Ring (Separate Sector) Cyclotron building. The facility will be completed in 1989 and will be used for proton and helium ion therapy. Recently, several hospitals have proposed to construct the dedicated proton therapy facilities. The National Cancer Center of Japan, and the PARMS of the University of Tsukuba have taken active parts in such projects. At present time, there is a step to make a decision of the type of accelerators. Another program is a construction of the NIRS Heavy Particle Medical Accelerator which is possible to provide Helium to Argon ions for therapy. The paper describes the accelerators for proton therapy and for heavy ion therapy in some detail.

41457 (LBL—22962, pp 93-115) **EULIMA Project.** Mandrillon, P.; Susini, A.; Ostojic, R.; Jongen, Y.; Meulders, J.P.; Ryckewaert, G. (Centre Antoine Lacassagne, Nice (France)). Apr 1987. NTIS, PC A11/MF A01. (CONF-861271—).

From 5. Particle Therapy Cooperative Group (PTCOG) meeting and international workshop on biomedical accelerators; Berkeley, CA, USA (1 Dec 1986).

At the European Organization for Research and Treatment of Cancer (EORTC) meeting held in Nice, on 18-19 October 1985, the idea of a EUropean LIght Ion Medical Accelerator has been proposed. On March 14, 1986 a group of potential medical users, radiobiologists, physicists and accelerator engineers from different European countries met at CERN to define the goals of the project and to examine the possibility to carry out a feasibility study. A request for funding for such a study has been submitted to the European Economic Community. The second meeting of the initiative group, held at CERN on 21st November 1986 initiated the feasibility study by setting up the Project Committee and a Scientific Council. The meeting also succeeded in providing more precise recommendations for the accelerator design. In this report the authors summarize the preliminary ideas underlying the project.

41458 (LBL—22962, pp 117-125) **Light Ion Biomedical Research Accelerator LIBRA.** Gough, R.A. Apr 1987. NTIS, PC A11/MF A01. (CONF-861271—).

From 5. Particle Therapy Cooperative Group (PTCOG) meeting and international workshop on biomedical accelerators; Berkeley, CA, USA (1 Dec 1986).

LIBRA is a concept to place a light-ion, charged-particle facility in a hospital environment, and to dedicate it to applications in biology and medicine. There are two aspects of the program envisaged for LIBRA: a basic research effort coupled with a program in clinical applications of accelerated charged particles. The operational environment to be provided for LIBRA is one in which both of these components can coexist and flourish, and one that will promote the transfer of technology and knowledge from one to the other. In order to further investigate the prospects for a Light Ion Biomedical Research Accelerator (LIBRA), discussions are underway with the Merritt Peralta Medical Center MPMC) in Oakland CA, and the University of California at San Francisco (UCSF). In this paper, a brief discussion of the technical requirements for such a facility is given, together with an outline of the accelerator technology required. While still in a preliminary stage, it is possible nevertheless to develop an adequate working description of the type, size, performance and cost of the accelerator facilities required to meet the preliminary goals for LIBRA.

41459 (LBL—22962, pp 129-134) **Plan for LLUPAF.** Slater, J.M. (Loma Linda Univ. Medical Center, CA (USA)). Apr 1987. NTIS, PC A11/MF A01. (CONF-861271—).

From 5. Particle Therapy Cooperative Group (PTCOG) meeting and international workshop on biomedical accelerators; Berkeley, CA, USA (1 Dec 1986).

Loma Linda University Proton Accelerator Facility, (LLUPAF), is being designed as a resource for: (1) the treatment of patients with cancer and some benign lesions using proton beam radiation; (2) education of medical and technical personnel for cancer patient management and research and (3) cancer and physics research. This paper examines the goals for the facility and planning strategy in the design of LLUPAF.

41460 (LBL—22962, pp 135-139) **Modern proton beam radiotherapy facility.** Awschalom, M. (Fermilab Medical Accelerator, Batavia, IL (USA)). Apr 1987. NTIS, PC A11/MF A01. (CONF-861271—).

From 5. Particle Therapy Cooperative Group (PTCOG) meeting and international workshop on biomedical accelerators; Berkeley, CA, USA (1 Dec 1986).

The planned proton beam therapy facility at the Loma Linda University Medical Center will meet the qualifications of a modern proton beam radiotherapy unit. In this paper, the author addresses those items in which Fermilab personnel has been taking an active participation, including accurate dose delivery, system reliability, flexibility and human engineering.

41461 (LBL—22962, pp 143-146) **Justification for constants used by LLUMCPTF to calculate shielding thicknesses.** Awschalom, M. (Fermilab Medical Accelerator Group, Batavia, IL (USA)). Apr 1987. NTIS, PC A11/MF A01. (CONF-861271—).

From 5. Particle Therapy Cooperative Group (PTCOG) meeting and international workshop on biomedical accelerators; Berkeley, CA, USA (1 Dec 1986).

There is very little published information on shielding characteristics measurements of any material against radiation produced by stopping 200-300 MeV protons. The only work is that of Distenfeld quoted by Alsmiller. There is also a measurement of neutron attenuation length at 500 MeV that supports Alsmiller's work. All modern shielding calculations covering the energy range of interest at Loma Linda University Proton Accelerator Facility (LLUMC) are based on the calculations of Bertini for intra nuclear cascades. Two works have been published for shielding in the 200 MeV region by Alsmiller and Braid. Three other works have been written as inhouse documents by Awschalom, Lundqvist and Smith, all based on Alsmiller's work. In this paper, the author examines the algorithm used to calculate radiation exposure, and compared some of the experimental data. The scant experimental data available supports the accuracy of Alsmiller's work. However, a safety factor of 4 in the dose rate has been incorporated in the algorithm used at Loma Linda Medical Center.

41462 (LBL—22962, pp 147-158) **Preliminary design study for a corkscrew gantry.** Koehler, A.M. (Harvard Cyclotron Lab., Cambridge, MA (USA)). Apr 1987. NTIS, PC A11/MF A01. (CONF-861271—).

From 5. Particle Therapy Cooperative Group (PTCOG) meeting and international workshop on biomedical accelerators; Berkeley, CA, USA (1 Dec 1986).

For two years or more a group including the author has been working together to study some problems related to the design of a gentry system for flexible direction of a proton beam for clinical treatments. Some consideration was given to the classic gantry geometry. Attempting to reduce the radius of the gantry arm by reducing the drift space after the scattering foils led to an analysis of the significance of inverse square intensity effects. The conclusion reached is that a drift space of about 3 meters is required to preserve some skin sparing for larger targets. To circumvent this problem the scattering foils ere put somewhere inside or even before the gantry system, accepting the fact that magnet apertures would have to be increased. This gantry system has the interesting ability to produce oblong fields of excellent uniformity with reasonable efficiency, preferentially with the long axis of the field parallel to the axis of rotation. It was disappointing, however, to find that the overall size of the gantry with its counterweights remained very large. Another change in geometry was proposed therefore in order to reduce the space taken up by the gantry and its counterweight. The beam is bent 45° in the horizontal plane and then again by 45° so that it is pointing away from isocenter, but in the plan of rotation of the gantry. The beam is now bent in that plane of rotation until it is pointed at isocenter. This is accomplished by two bends of 135° each with a suitable drift space between them so that the beam is pointed vertically downward at isocenter. The three dimensional complexity of the beam trajectory led to the name Corkscrew Gantry.

41463 (LBL—22962, pp 161-168) **Capabilities of passive beam-spreading techniques.** Gottschalk, B. (Harvard Cyclotron Lab., Cambridge, MA (USA)). Apr 1987. NTIS, PC A11/MF A01. (CONF-861271—).

From 5. Particle Therapy Cooperative Group (PTCOG) meeting and international workshop on biomedical accelerators; Berkeley, CA, USA (1 Dec 1986).

In this note the authors confine themselves to the throw (first scatterer to isocenter distance) required for transverse dose flattening if the double scattering technique is used. Given the input energy, throw, required dose uniformity, and required residual range, there is a maximum flat-field radius that can be achieved. For instance, 250 MeV, 3 m throw, +/- 2.5% flatness and ~ 23 cm H_2O residual range lead to ~ 25 cm useful radius. The field radius increases in proportion to the throw. As a guide in deciding how much distance must be allotted to preserve the double scattering option in a beamline or gantry, a graph of residual range vs. useful radius is presented for 200 and 250 MeV and a throw of 3 m.

41464 (LBL—22962, pp 169-183) **Dynamic beam delivery system: the wobbler.** Renner, T.R. Apr 1987. NTIS, PC A11/MF A01. (CONF-861271—).

From 5. Particle Therapy Cooperative Group (PTCOG) meeting and international workshop on biomedical accelerators; Berkeley, CA, USA (1 Dec 1986).

Previously at the Biomed facility at the Bevelac the beam shaping was accomplished using two scattering foils and an occluding ring assembly often referred to as a double scattering system. The disadvantages of this double scattering system are: (1) the absorbing material in the beam shorten the residual range of the beam particles, (2) the absorbing material, especially the low-Z material in the water column, produces nuclear fragments, and (3) the occluding ring assembly and the scatterers reduce the fraction of the beam delivered to the target volume. The double scattering method cannot be easily extended to heavier ions, which scatter less and fragment more in a given scatterer thickness. The newly developed wobbler beam delivery system overcomes many of the disadvantages encountered in the double-scattering system. In the wobbler system the lateral broadening of the beam completely relies on magnetic deflection and eliminates the needs for the scattering material in the beam. Fields as large as 30 cm in diameter are easily achievable. The wobbler system lowers the contamination by radiobiologically inferior fragments in the beam. The removal of the scattering material from the beam path also reduces the divergence of the beam and consequently improves the sharpness of the penumbra of the collimated beams.

41465 (LBL—22962, pp 185-196) **Limitations of dynamic beam delivery systems.** Chu, W.T.; Kuenning, R.W. Apr 1987. NTIS, PC A11/MF A01. (CONF-861271—).

From 5. Particle Therapy Cooperative Group (PTCOG) meeting and international workshop on biomedical accelerators; Berkeley, CA, USA (1 Dec 1986).

The heavy charged-particle beams which have been extracted from the accelerator and channeled to the treatment rooms are usually small in diameter compared to the target volumes. Many different methods have been devised to spread out the beams in order to cover the entire target volume with a uniform dose. When using the double-scattering beam delivery method, the entire target volume is irradiated simultaneously; whereas, in the other beam delivery methods, such as the wobbler system or the raster scanning system, a relatively small beam spot is moved around to cover the entire target volume with a uniform dose and only a part of the target volume is irradiated at a time. The latter methods are therefore called dynamic beam delivery methods, and the double scattering method is called a passive beam delivery method. In this note, the dose uniformities achievable using the dynamic beam delivery systems are analyzed, and the requirements placed on the systems specifications are discussed.

41466 (LBL—22962, pp 199-206) **NMR and pet imaging in beam localization.** Valk, P.E. Apr 1987. NTIS, PC A11/MF A01. (CONF-861271—).

From 5. Particle Therapy Cooperative Group (PTCOG) meeting and international workshop on biomedical accelerators; Berkeley, CA, USA (1 Dec 1986).

Positron emission tomography (PET) and nuclear magnetic resonance (NMR) imaging are the most recent developments in diagnostic imaging and the authors have used these techniques at LBL for pre-treatment and follow-up imaging of cerebral tumors and tumors of the head and neck. The data obtained by these two techniques are very different. In NMR imaging, the image signal is determined by mobile proton density and T1 and T2 relaxation parameters. Proton density is most commonly altered by changes in tissue water and NMR is very sensitive to such changes. There are also significant differences in free proton content and relaxation parameters between different normal tissues, so that NMR images are rich in anatomic detail. In PET, images are by definition functional rather than anatomic, as they always reflect the biological behavior of injected positron-emitting radionuclides and different molecules act as tracers of different physiologic functions. The tracers that we use most commonly in cerebral tumor imaging are three: (i) Rubidium-82 (Rb), which is excluded from the normal brain by the blood-brain barrier (BBB), (ii) F-18-2 fluoro-deoxyglucose (FDG), which reflects glucose uptake, and (iii) I-122-HIPDM, which demonstrates brain tissue perfusion.

41467 (LBL—22962, pp 207-212) **Correlating NMR and x-ray CT imaging for therapy planning.** Kessler, M.L. (Univ. of California, Berkeley (USA)). Apr 1987. NTIS, PC A11/MF A01. (CONF-861271—).

From 5. Particle Therapy Cooperative Group (PTCOG) meeting and international workshop on biomedical accelerators; Berkeley, CA, USA (1 Dec 1986).

To appropriately incorporate NMR imaging into standard therapy treatment planning systems, the authors have developed methods to allow the therapist to interactively define regions or volumes of interest (VOI) on a set of NMR images and have these regions accurately transferred to CT image data. These methods include reproducing patient geometry; point to point fitting; and surface fitting techniques. The choice of method depends on the particular clinical situation.

41468 (LBL—22962, pp 213-230) **Diagnostic applications of radioactive beams.** Chatterjee, A.; Llacer, J.; Collier, M.; Renner, T.; Henderson, S.; Chu, W. Apr 1987. NTIS, PC A11/MF A01. (CONF-861271—).

From 5. Particle Therapy Cooperative Group (PTCOG) meeting and international workshop on biomedical accelerators; Berkeley, CA, USA (1 Dec 1986).

The Bragg peak therapy of cancer patients with protons and heavier charged particles requires a very careful treatment planning involving the precise localization of the peak on a tumor volume. The present day techniques depend upon CT measurements which may not be as reliable as desired, especially when there is a large amount of thick bone of air path. In this report, the authors are presenting a newly developed technique which utilizes high energy radioactive beams and a sensitive positron camera and provides a direct way of measuring the water equivalent path-length as traversed by a treatment-beam. The most commonly used radioactive beam has been ^{19}Ne so far; however, the technique is not limited to this particular isotope. It should be noted that the energetic radioactive particles have penetration properties that are very similar to the heavy charged particles used in Bragg peak therapy.

41469 (LUNFD6-NFRA—1020-1-55(1987)) **Radioactive colloids.** Bergqvist, L. (Lund Univ. (Sweden). Dept. of Radiation Physics). 10 Mar 1987. 59p. (LUMEDW-MERI—1020-1-55(1987)). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88752492/JAW.

Different techniques for the characterization of radioactive colloids, used in nuclear medicine, have been evaluated and compared. Several radioactive colloids have been characterized in vitro and in vivo and tested experimentally. Colloid biokinetics following interstitial or intravenous injection were evaluated with a scintillation camera technique. Lymphoscintigraphy with a Tc-99-labelled antimony sulphur colloid was performed in 32 patients with malignant melanoma in order to evaluate the technique. Based on the biokinetic results, absorbed doses in tissues and organs were calculated. The function of the reticuloendothelial system has been evaluated in rats after inoculation with tumour cells. Microfiltration and photon correlation spectroscopy were found to be suitable in determining activity-size and particle size distributions, respectively. Maximal lymph node uptake following subcutaneous injection was found to correspond to a colloid particle size between 10 and 50 nm. Lymphoscintigraphy was found to be useful in the study of lymphatic drainage from the primary tumour site in patients with malignant melanoma on the trunk. Quantitative analysis of ilio-inguinal lymph node uptake in patients with malignant melanoma on the lower extremities was, however, found to be of no value for the detection of metastatic disease in lymph nodes. High absorbed doses may be received in lymph nodes (up to 1 mGy/MBq) and at the injection site (about 10 mGy/MBq). In an experimental study it was found that the relative colloid uptake in bone marrow and spleen depended on the total number of intravenously injected particles. This may considerably affect the absorbed dose in these organs. 148 refs.

41470 **Heterogeneous ventilation and perfusion: a sensitive indicator of lung impairment in nonsmoking coal miners.** Susskind, H.; Acevedo, J.C.; Pate, H.R.; Harold, W.H.; Brill, A.B.; Iwai, J.; Rasmussen, D.L.; Heydinger, D.K. (Medical Research Center, Brookhaven National Laboratory, Upton, New York (US); Department of Medicine, Marshall University School of Medicine, Huntington, West Virginia (US); Department of Family and Community Health, Marshall University School of Medicine, Huntington, West Virginia (US)). *European Respiratory Journal;* **1**: 232-241(1988).

Twenty life-long nonsmoking West Virginia coal-miners participated in a study to amplify the role of focal irregularities on regional ventilation (V/sup ./) and perfusion (Q/sup ./) and to develop an improved method for the early detection of coal-workers' pneumoconiosis. Their mean age was 59.3 yr and they averaged 35.2 years' exposure to coal dust. Conventional pulmonary function tests were supplemented by measurement of V/sup ./,Q/sup ./ and lung volume (V), using radioactive Kr-81m, Tc-99m MAA and Xe-127, respectively, to determine regional abnormalities in lung function. A computer analysis of the regional distributions of V/sup .// V and Q/sup .//V were significantly reduced in the lower third, and increased in the upper two-thirds of the miners' lungs; V/sup .//Q/sup ./ was reduced in the upper half. The miners' V/sup .//V and Q/sup .//V were more heterogeneous than that of eleven age-matched controls, with mean ventilation HI values of 0.190+-0.027 and 0.133+-0.011, respectively, and mean perfusion HI values of 0.206+-0.022 and 0.164+-0.041, respectively. P(A-a)O/sub 2/ correlated positively with ventilation HI. Gas exchange was the most significant functional measurement, being abnormal in 19/20 subjects. In contrast, conventional spirometric measurements were within the predicted normal limits in all but four miners.

41471 **Mass mapping with the scanning transmission electron microscope.** Wall, J.S.; Hainfeld, J.F. (Biology Dept., Brookhaven National Lab., Upton, NY 11973 (USA)). pp 355-376 of Annual review of biophysics and biophysical chemistry, Volume 15. Engelman, D.M. Palo Alto, CA; Annual Reviews Inc. (1986). Contract AC02-76CH00016.

The scanning transmission electron microscope (STEM) has established a comfortable niche in the field of biological instrumentation through use of its quantitative imaging process for mass analysis of single molecules. The more traditional methods of mass measurement (e.g. chromatography, centrifugation, light, small-angle X-ray, and neutron scattering) measure averages over a total population, whereas the STEM can examine one molecule at a time, giving total mass, size and shape, internal mass distribution, and degree of departure from a standard or model. Although simple mass measurements continue to be a "bread and butter" application, the authors are attempting to enlarge our niche in three directions: (a) inference of dynamic solution conformation from images of molecules prepared under various conditions, (b) two- and three-dimensional determination of mass distribution of complex objects, and (c) labeling of specific sites with heavy atom clusters.

41472 **Potential new approaches for the development of brain imaging agents for single-photon applications.** Knapp, F.F. Jr.; Srivastava, P.C. (Oak Ridge National Lab., Oak Ridge, TN (US)). pp 71-84 of Amphetamines and pH-shift agents for brain imaging: Basic research and clinical results. Biersack, H.J.; Winkler, C. Hawthorne, NY; De Gruyter (Walter), Inc. (1986).

The goals of this paper are to describe new strategies being pursued at several institutions for the brain-specific delivery of radionuclides that can be used to evaluate regional cerebral perfusion by single photon imaging techniques. A comprehensive review of the literature is beyond the scope of these proceedings and our goal is to, therefore, present a description of several examples of interesting new strategies that have recently been reported. In addition, the authors also describe a new approach being pursued at their institution for the brain-specific delivery of radioiodinated iodophenylaklyl-substituted dihydronicotiamide systems which shows good brain uptake and retention in preliminary studies in rats. Following transport into the brain these agents appear to undergo facile intracerebral oxidation to the quaternized analogues which do not cross the intact blood-brain-barrier and are effectively trapped in the brain.

41473 **Pharmacologic manipulation to enhance diagnostic imaging in adrenal gland scintigraphy.** Gross, M.D.; Shapiro, B. pp 76-117 of Diagnostic interventions in nuclear medicine. Thrall, J.H.; Swanson, D.P. Chicago, IL; Year Book Medical Publishers (1985).

Pharmacologic manipulation of adrenal gland function was first used to enhance the biochemical diagnosis of adrenal cortical and adrenal medullary disease. Scintigraphy depends on the specific adrenal accumulation of a radiopharmaceutical (ie, iodine 131 (/sup 131/I)-labelled 19-iodocholesterol [cortex], /sup 131/I-labeled 6β-iodomethylnorcholesterol [NP-59] [cortex], selenium 75 (/sup 75/Se)-labeled 6β-selenomethylnorcholesterol [cortex] or /sup 131/I-labeled metaiodobenzylguanidine [medulla], and the pattern and degree of radiotracer uptake can, like the biochemical parameters, be altered by pharmacologic manipulation to improve diagnostic accuracy. The relationship of alterations of cortical and medullary function to the accumulation of these radiopharmaceuticals has recently been demonstrated. The scintigraphic studies can be integrated with the other complementary tests of radiodiagnosis that demonstrate increased spatial resolution (computed tomography and ultrasound) but do not define organ function. This chapter focuses on the important pharmacologic manipulations that are used in the scintigraphic approach to the localization and functional characterization of the adrenal cortex and medulla.

5507 Microbiology

REFER ALSO TO CITATION(S) 39322, 39498, 39504, 41637

5509 Pathology

REFER ALSO TO CITATION(S) 39482, 39619, 41228, 41302, 41357, 41398, 41420, 41575, 41576, 41577, 41578, 41579, 41584, 41592

41474 (CONF-8703182—Summs., pp 105) **Spontaneous neoplastic evolution: immortalization and recurrent chromosome changes of Chinese hamster cells.** Ray, F.A.; Kraemer, P.M.; Bartholdi, M.F.; Cram, L.S. (Los Alamos National Lab., NM (USA)). 1987. NTIS, PC A07/MF A01. Order Number DE88002817/JAW.

From Conference on cellular molecular aspects, radiation induced DNA damage and repair; Albuquerque, NM, USA (10 Mar 1987).

The acquisition of the trait for unlimited proliferative potential is likely to be a key element in neoplastic evolution. This immortalization step is the first observable change in an in vitro model of spontaneous neoplastic progression using Chinese hamster cells. Fluctuation analyses were used to establish the rate of immortalization at 2 x 10^{-6} per cell per generation which is suggestive of a single genetic mutation. Chromosomes of newly immortalized cells were examined for recurrent changes. The karyotypes were studied by G-banding and flow karyology. Cells cloned immediately after initiation into culture or cells allowed to grow as mass cultures developed frequently recurring changes of karyotype involving extra copies of chromosome 3/sub q/ (18/22) and chromosome 5 (14/22). Paradoxically, none of five mod-crisis clones had trisomy of chromosome 3/sub q/ and one of five had additional copies of chromosome 5 at the earliest passage examined. None of the observed chromosome changes would be tightly correlated to the acquisition of tumorigenicity in athymic mice.

41475 (DOE/BP—899, pp 80-88) **Diseases of migrating smolts.** Rohovec, J.S. (Oregon State Univ., Corvallis (USA)). May 1987. NTIS, PC A12/MF A01. Order Number DE88003264/JAW. (CONF-8505378—).

From Workshop on smoltification and related research; Warm Springs, OR, USA (20 May 1985).

Very few studies have been conducted concerning diseases of smolts and the impact pathogens have on the survival of the fish as they migrate and enter salt water. Their laboratory has done some very limited work in this area which will be described. The

authors began studying what effect bacterial kidney disease (BKD) has on fish entering salt water. Preliminary tests were done with chinook salmon from three different locations in the Willamette River system. Fish which had attained a sufficient size were released in the fall, and the remainder of the populations were reared through the winter and released in the spring. In the fall and again in the spring, 300 fish from each of the three sites were collected. A sample of 100 fish from each group was examined for the incidence of BKD using a fluorescent antibody technique (FAT). The remaining 200 fish were separated into two equal lots and placed in tanks supplied with UV-sterilized sea water. The fish which died in salt water and the survivors were all examined for BKD using FAT.

41476 **(PB—88-188826/XAB) Request for assistance in reducing the potential risk of developing cancer from exposure to gallium arsenide in the microelectronics industry.** (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). Oct 1987. 12p. (DHHS/PUB/NIOSH—88-100). NTIS, PC A03/MF A01.

Various methods through which exposure to gallium-arsenide might be reduced in the microelectronics industry were discussed. While there were no reported studies showing ill effects in workers from exposure to gallium arsenide or gallium particulates, three studies in animals indicated that gallium arsenide dissociates into gallium and arsenic in biological tissue, the latter being a carcinogen. NIOSH Recommended Exposure Limit (REL) for arsenic was 2 micrograms/cubic meter air (microg/cu m). NIOSH recommends control of worker exposure to gallium arsenide by observing NIOSH REL for inorganic arsenic, and that concentration of gallium arsenide in air be estimated by determining arsenic. Workers should be educated in possible hazards connected with gallium arsenide exposure. Proper engineering controls should be installed during production of microelectronic devices where exposure to gallium-arsenide is likely. Personal protective clothing and equipment should be available to workers, and proper procedures for washing, removal of wastes, transport, and disposal of contaminated materials should be explained and carried out. Specific safety recommendations are offered for use during crystal growth, crystal puller cleaning, crystal surface grinding and sawing, and wafer polishing, backlapping, and dicing.

41477 **(PB—88-188859/XAB) Chemicals/processes classified as carcinogens.** Newman, J.W.; Schoenborn, T.F.; Tatken, R.L. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). 30 Apr 1985. 223p. NTIS, PC A10/MF A01.

Chemicals and processes which have been deemed as having carcinogenic potential by the International Agency for Research on Cancer (IARC), the National Toxicology Program, NIOSH, OSHA, or the American Conference of Governmental Industrial Hygienists (ACGIH) were compiled in a tabular listing. The document indicated the category which each of the agencies specified for each chemical compound or process. These categories differentiated between substances or processes which are known to be carcinogens in humans, which are probably carcinogenic to humans, which give sufficient evidence of carcinogenicity in laboratory animals, which have potential for carcinogenicity, which are currently regulated by OSHA as carcinogens, which are currently regulated by OSHA for reasons other than carcinogenicity, and human carcinogens with or without ACGIH assigned threshold limit values. Also indicated were IARC laboratory reference compounds. Synonyms for the compounds were listed and grouped by their Chemical Abstracts Service Registry Numbers. An alphabetical listing of these synonyms was also provided. Over 180 different chemicals and processes are listed.

41478 **(PB—88-196324/XAB) Human variability in susceptibility to toxic chemicals: a preliminary analysis of pharmacokinetic data from normal volunteers.** Hattis, D.; Erdreich, L.; Ballew, M. (Environmental Protection Agency, Cincinnati, OH (USA). Office of Environmental Criteria and Assessment). 1987. 12p. (EPA—600/J-87/320). NTIS, PC A03/MF A01.

Pub. in Risk Analysis, Vol. 7, No. 4, 415-424(1987). See also PB—87-101242.

The tenfold uncertainty factor traditionally used to guard against human interindividual differences in susceptibility to toxicity is not based on human observations. To begin to build a basis for quantifying an important component of overall variability in susceptibility to toxicity, a data base has been constructed of individual measurements of key pharmacokinetic parameters for specific substances (mostly drugs) in groups of at least five healthy adults. 72 of the 101 data sets studied were positively skewed, indicating that the distributions are generally closer to expectations for log-normal distributions than for normal distributions. Measurements of interindividual variability in elimination half-lives, maximal blood concentrations, and AUC (area under the curve of blood concentration by time) have median values of log/sub 10/ geometric standard deviations in the range of 0.11-0.145. For the median chemical, therefore, a tenfold difference in these pharmacokinetic parameters would correspond to 7-9 standard deviations in populations of normal healthy adults.

41479 **(PB—88-210869/XAB) Genetic engineering and biological weapons.** Jaurin, B.; Norlander, L.; Boelin, I.; Forsberg, A.; Forsman, M. (Foersvarets Forskningsanstalt, Umeaa (Sweden)). Nov 1987. Translation of mono. Genteknik och Biologiska Stridsmedel, Umea, 1987 144p. (FOA-A—40058-4.4). 144p. NTIS, PC E07/MF E07.

The disciplines of biology and medicine are developing very rapidly. With the development of genetic engineering, the potential threat from more complex, unique, very toxic and hitherto unknown pathogens has become a reality. In addition to the development of new and unknown weapons, genetic engineering offers the possibilities for new vaccines and diagnostic methods. In order to judge the threats poised by international developments in this area, a continuous and active analysis of the possibilities of genetic engineering is being carried out. A portion of that work is presented in this report. The topics include: working methods in genetic engineering; cultivation of genetically altered cells; genetic engineering of plants; genetic engineering of pathogenic microorganisms; factors that can cause injury to humans; factors related to microorganism survival; diagnostics; vaccines.

41480 **Eradication of infectious diseases in heterogeneous populations.** Travis, C.C.; Lenhart, S.M. (Oak Ridge National Lab., TN (USA)). *Mathematical Biosciences*; 83: No. 2, 191-198(Apr 1987).

A model is presented of infectious disease in heterogeneous populations, which allows for variable intra- to intergroup contact ratios. The authors give necessary and sufficient conditions for disease eradication by means of vaccination. Smallpox is used as an illustrative example.

5510 Physiological Systems

41481 **(AD-A—191359/9/XAB) Improvements in the methodology for analyzing receptor subtypes and neuronal populations affected by anticholinesterase exposure. Annual summary report, 15 November 1983-14 November 1984.** Wamsley, J.K. (Utah Univ., Salt Lake City (USA). School of Medicine). 14 Nov 1984. 18p. NTIS, PC A03/MF A01.

Conditions were defined that provide a means of selectively labeling subtypes of muscarinic receptors. The so-called M1 receptor population can be labeled with tritiated pirenzepine, while the receptor population labeled with tritiated quinuclidinyl benzilate (QNB) but not labeled with pirenzepine represents M2 receptor population. High- and low-affinity states of the receptors were also defined on the basis of agonist displacement of antagonist binding. Both the M1 and M2 receptor populations undergo axonal transport and the affinity states of these receptors are altered by neurochemical and neurosurgical lesions. Radioactive standards were developed that provide a means of quantitating the femtomoles of receptor bound with each ligand in microscopic regions of the brain. The technology was also devised to directly localize nicotinic cholinergic receptors using tritiated nicotine. It is now possible to localize several peptide receptors associated with cholinergic function including receptors for thyrotropin-releasing hormone (TRH) and somatostatin. The receptor autoradiographic technique was also carried beyond the receptor level of localization by using com-

pounds to label adenylate cyclase and the GTP binding protein. This methodology should provide an elegant means of determining how anticholinesterase exposure has affected these many parameters of cholinergic nerve function.

41482 (DOE/BP—899, pp 89-96) **Stress measurement.** Schreck, C.B. (Oregon State Univ., Corvallis (USA)). May 1987. NTIS, PC A12/MF A01. Order Number DE88003264/JAW. (CONF-8505378—).

From Workshop on smoltification and related research; Warm Springs, OR, USA (20 May 1985).

An overview is presented of the art of stress physiology in fish. The author gives an example of how this knowledge of basic physiology can have management implications. Lastly, he concludes with consideration of what they need to know - broad aspects of the problems to which they do not known the solutions yet.

41483 (DOE/BP—899, pp 109-119) **Sex control strategies.** Donaldson, E.M. (Dept. of Fisheries and Oceans, Vancouver, British Columbia (Canada)). May 1987. NTIS, PC A12/MF A01. Order Number DE88003264/JAW. (CONF-8505378—).

From Workshop on smoltification and related research; Warm Springs, OR, USA (20 May 1985).

Salmon lend themselves to a wide range of culture strategies. As in some other vertebrates, one can induce ovulation and spermiation and regulate the time of spawning. When gametes are produced, the option is available of storing the sperm or eggs for a short period, or the sperm for an indefinite period. In addition, owing to the inherent flexibility of teleost reproductive mechanisms and the external fertilization process, there is the opportunity during early development to produce, not just regular fry (i.e., mixed males and females), but all-female fry or totally sterile fry by a variety of techniques. The author will discuss first the production of sterile salmonids and the reasons for producing them in certain situations, and then the production, by various techniques, of female fry only. For the Columbia River, the production of all females is probably of particular interest.

41484 **(INIS-mf—11713) Blood circulation of the inner ear under the influence of medications. Radiotracer experiments using guinea pig cochlea.** Neumeier, A. (Wuerzburg Univ. (Germany, F.R.). Medizinische Fakultaet). 11 Feb 1987. 127p. (In German). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88753813/JAW.

The dependence of the blood circulation in the inner ear on various medications is discussed. By means of a radiotracer clearance technique the cochlear clearance curves for the guinea pig cochlea after the administration of various circulation stimulants were determined. (MBC)

5520 Public Health

REFER ALSO TO CITATION(S) 39105, 40021, 41185, 41186, 41187, 41188, 41189, 41190, 41191, 41192, 41193, 41194, 41196, 41215, 41217, 41220, 41221, 41239, 41240, 41476, 41477, 41592

41485 **(PB—88-188784/XAB) Pharmacokinetic/mechanism-based analysis of the carcinogenic risk of ethylene oxide.** Hattis, D. (Massachusetts Inst. of Tech., Cambridge (USA). Center for Technology, Policy and Industrial Development). Aug 1987. 225p. (CTPID—87-1). NTIS, PC A10/MF A01.

An attempt was made to build an integrated series of pharmacokinetic models for low-molecular-weight alkylating agents in efforts to expand the understanding of risk assessment for various occupational carcinogens. The purpose was to allow for better assessment of biologically effective doses of activated metabolites delivered to target tissues and to arrive at a better translation of such units between species. The approach to pharmacokinetic modeling of ethylene oxide was defined, and specific results were presented. Longer elimination was predicted to increase internal dose, so that greater internal doses would be expected in man compared to rodents. Lower respiration per body weight in man would decrease absorption rate, offsetting the higher predicted internal dose. In terms of human cancer risk, it is stated that substantial data are available showing carcinogenic response of rats and mice to ethylene oxide. Equations are presented showing the risk resulting for different sites, species, and sexes using the measure of delivered dose in a multistage model. Implications for overall human cancer risk from 45 years 8 hours per day occupational exposure to 1 part per million ethylene oxide were presented. Doses used in analysis did not yield markedly divergent estimates of human risk. The authors conclude that, for a simple direct-acting alkylator like ethylene oxide, traditional approaches for dose and risk projection across species are supported by pharmacokinetic-based analysis.

41486 **(PB—88-189428/XAB) NIOSH (National Institute for Occupational Safety and Health) alert reprints: October 1980-December 1986.** (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). Sep 1987. 137p. (DHHS/PUB/NIOSH—87-119). NTIS, PC A07/MF A01.

A total of 13 NIOSH Alerts published since 1980 were reprinted in this volume. Hazards dealt with in these Alerts included: 2-nitropropane; benzidine, o-tolidine, and o-dianisidine based dyes; controlling carbon monoxide hazard in aircraft refueling operations; electrocutions of workers in fast-food restaurants; injury of workers by robots; electrocutions from contact between cranes and power lines; deaths and injuries from excavation cave-ins; hazards in the use of water spray or fog streams to prevent or control ignition of flammable atmospheres; occupational fatalities in confined spaces; grain-auger electrocutions; fatalities due to fires and explosions in oxygen-limiting silos; electrocutions due to damaged receptacles and connections; and fatalities of workers contacting electrical energy. These Alerts were reprinted exactly as they first appeared and, therefore, contained no updated material.

41487 **(PB—88-203062/XAB) Guidelines to format standards for NIOSH (National Institute for Occupational Safety and Health) criteria documents: chemical hazards.** (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). Feb 1973. 45p. NTIS, PC A03/MF A01.

This guide was prepared to assist anyone preparing a criteria document in obtaining standardized reporting and to aid in moving along the publication of such documents in a timely manner. These guidelines pertained to the publication of criteria documents dealing with a chemical hazard only and not with safety and physical hazards which require the reporting of slightly different information. The guidelines offer suggestions for defining the different parts of the criteria documents, chapter format, how to list references cited, use of literature citations in the text material, and proper abbreviations. An example of a chapter layout is presented. Also included in the report are proper labeling restrictions, results of medical and environmental monitoring, the need for personal protective equipment, sanitation procedures, and record-keeping requirements.

41488 **(PB—88-865522/XAB) Styrenes: industrial health hazards, January 1977-June 1988 (Citations from the Rubber and Plastics Research Association data base). Report for January 1977-June 1988.** (National Technical Information Service, Springfield, VA (USA)). Jun 1988. 88p. NTIS PC N01/MF N01.

Supersedes PB—85-871879.

This bibliography contains citations concerning the effects of styrene toxins on work forces in industrial plastic manufacturing and processing. Occupational hygiene, pharmokinetics, pharmacodynamics, biotransformation, mutagenesis, teratogenesis, carcinogenesis, neurotoxicity and fatality rates of exposed workers are also included. Occupational-health saftey regulations and legislation is discussed. (This updated bibliography contains 211 citations, 32 of which are new entries to the previous edition.)

5530 Agriculture And Food Technology

REFER ALSO TO CITATION(S) 39478, 39479, 39480, 39481, 39483, 39484, 39485, 39486, 39487, 39488, 39489, 39490, 41140

41489 (CTRFAS—1393) Technical evaluation of gamma-irradiation pretreatment on quality preservation for fresh fish. Ke, P.J.; Linke, B.A.; Lemon, D.W.; Regier, L.W. (Department of Fisheries and Oceans, Halifax, Nova Scotia (Canada). Fisheries Development Branch). Jul 1985. 22p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702639/JAW.

A comprehensive review and evaluation on the use of gamma-irradiation for preserving fresh fish quality has been made. The advantages and limitations of using gamma-irradiation of less than 1 M rad have been re-evaluated and compared with previous tests at the Halifax laboratory in terms of physical, organoleptic and some post process quality assessments. Cod, mackerel, and scallop were chosen as the models for lean, fatty and shell fish respectively. The irradiation process can prevent bacterial spoilage in fish, particularly when chilling and/or handling practices are inadequate, but the potential catalytic influences on enzymatic and chemical deterioration during the post-mortem period should also be considered. Some considerations and reservations concerning the changes in overall quality for irradiated fish are discussed. Before more research is completed, the gamma-irradiation process should not be used for shellfish, fatty fish and various prepared and frozen fish products made from Canadian Atlantic species.

41490 (DOE/CH/10288—T2) Radiation induced changes in the cuticular hydrocarbons of the granary weevil and their relationships to desiccation and adult mortality: Quarterly report, February 15, 1988-May 15, 1988. (Selma Univ., AL (USA). Div. of Natural and Applied Sciences). [1988]. Contract FG02-86CH10288. 19p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88011520/JAW.

The overall goals and objectives as envisaged for the year (1988) have been pursued. The report of the work may broadly be outlined into three components: post irradiation mortality studies at different combinations of temperature and humidity (studies on the rate of moisture-loss in irradiated weevils and correlation with mortality): preliminary studies on the spiracles of the treated and untreated granary weevils; and extraction of epicuticular hydrocarbons Sitophilus granarius (L) for both irradiated and control (elucidate the after effects of irradiation and determination of radiation induced changes if any, in the cuticular hydrocarbons of weevils as a result of gamma radiation). 6 refs., 2 figs., 6 tabs.

41491 (IC—87/250) Fluid transport across capillary walls in lymphatic circulation - I. Bestman, A.R. (International Centre for Theoretical Physics, Trieste (Italy)). Aug 1987. 17p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702966/JAW.

Fluid transport in multi capillary system in the pulmonary circulation is modelled as flow between adjacent channels. One channel (the tissue) is an indistensible permeable medium with permeability K while the other channel (the blood vessel) is a free space and distends except at the common boundary. The distensibility which is small is characterized by a parameter ϵ. Asymptotic expansion for small ϵ is developed and the only matching condition required is the continuity of velocity components at the common boundary. The pressure in the tissue is then reduced to the solution of a linear Fredholm integral equation of the first kind whose kernel is obtained from the equation of the distensible wall. Consequences of the effect of K on the various flow parameters are discussed quantitatively. (author). 5 refs, 4 figs.

41492 (IC—87/253) Fluid transport across capillary walls in lymphatic circulation - II. Bestman, A.R. (International Centre for Theoretical Physics, Trieste (Italy)). Aug 1987. 14p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702969/JAW.

In this part, the problem of part I is extended to the case where the forcing pressure, across the capillary, is purely oscillatory. The Fredholm integral equation for determination of the pressure in the tissue may be solved in a close form for limiting cases of the Wormesley parameter σ. In the higher approximation, the discussion is centred on the steady state streaming solutions. The effect of σ and the permeability parameter K on the pressure loading of the heart is highlighted. It is hoped this will shed light on the pathological pulmonary edema. (author). 3 refs, 2 figs.

41493 (INIS-mf—11141) Effect of gamma irradiation on mortality of tribolium castaneum (HERBST). Rita Muhamad Awang. (Agricultural Univ. of Malaysia, Serdang, Selangor). [1987]. 8p. NTIS (US Sales Only), PC A02/MF A01 - To be published in Journal of Malaysian Applied Biology. (1987). v. 16(2).. Order Number DE88703251/JAW.

An investigation was made to assess the susceptibility of larvae and adults of Tribolium castaneum to gamma irradiation. The larvae were more susceptible to irradiation than the adults. A dose of 0.05 kGy killed all the larvae but higher dose of 0.15 kGy was required to kill all the adults. Therefore, a dose of 0.15 kGy was found to be the effective dose to kill both the larvae and the adults of T. castaneum.

41494 (Juel—2166) Interactions between shoots and roots of two soy bean varieties at different phosphate nutritional level: Distribution of ^{14}C-assimilates and carbohydrate status. Burauel, P. (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Radioagronomie; Bonn Univ. (Germany, F.R.)). Nov 1987. 124p. (In German). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88753826/JAW.

The influence of the phosphate nutritional status on assimilate distribution between shoot and root was studied for two soya bean varieties (Century and Woodworth). Plants at a full nutritional level (+P variants) and those in a condition of moderate P stress (-P variants) were considered. Particular attention was paid to the following aspect: Is a modification of the assimilate distribution, conditioned by phosphate withdrawal, only associated with the reduction in the shoot/root ratio or do changes in distribution already occur before morphological parameters are influenced? Further it is known from literature that after a contemporary interruption of the phoshate supply plants display an increased phosphate uptake rate when the supply is restored in comparison to plants nourished normally. In this respect the following aspects were of interest: Does an increased uptake rate, for which sufficient energy must be made available, have a direct effect on the transport of assimilates to the root? Is the carbohydrate content of the roots possibly a parameter with which the difference in efficiency of the two varieties may be described? (orig./MG)

41495 (ORNL/TM—10729) Breeding Multigeneration Support System requirements analysis for NCTR [National Center for Toxicological Research], 04 February 1988. Bengtson, P.Y.; Strand, R.; Sjoreen, A. (Oak Ridge National Lab., TN (USA)). May 1988. Contract AC05-84OR21400. 95p. NTIS, PC A06/MF A01; 1; GPO Dep. Order Number DE88013125/JAW.

This study is a definition of the requirements for a Breeding Multigeneration Support System (BMSS) to be used by the National Center for Toxicological Research (NCTR). The BMSS will maintain management and planning information of a breeding colony of rodents maintained at NTCR. BMSS is a computer software support system which is being developed to collect and maintain information to manage the animal breeding functions, the allocation of animals to experiments, and control the breeding of animals within multigeneration experiments. Further work will result in an external design, internal design, and finally prototype software which will be thoroughly tested in actual use at NCTR. 41 figs.

41496 (PB—88-863410/XAB) Nuclear magnetic resonance: applications in the food industry. January 1972-April 1988 (Citations from the Food Science and Technology Abstracts data base). Report for January 1972-April 1988. (National Technical Information Service, Springfield, VA (USA)). May 1988. 148p. NTIS PC N01/MF N01.

This bibliography contains citations concerning the applications of nuclear magnetic resonance (NMR) imaging in the food industry. Analysis of flavor compounds, moisture content, fat crystal-

lization, protein soluability, pigments, and compounds that preserve foods are discussed. Chemical changes in processed foods and biological processes such as plant growth and reapiration are also studied. (Contains 333 citations fully indexed and including a title list.)

56 BIOMEDICAL SCIENCES, APPLIED STUDIES

REFER ALSO TO CITATION(S) 40009

41497 **(INIS-mf—11766) Investigations of radiation-induced covalent cross-links between macromolecules in E. coli bacteria.** Grosskopf, R.M. (Erlangen-Nuernberg Univ., Erlangen (Germany, F.R.). Medizinische Fakultaet). 18 Jul 1983. 106p. (In German). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88754167/JAW.

The author investigates the radiation-induced formation of covalent cross-links between biomolecules after in-vivo irradiation. Intact E. coli cells and isolated cytosol were exposed to X-ray radiation. After lysis of the exposed bacteria or after exposure of the isolated cytosol, changes in the cell constituents were analyzed, with particular regard to the generation of covalent cross-links between nucleic acids and proteins. The methods employed were the recording of UV absorption spectra and gel chromatography.

5601 Radiation Effects

REFER ALSO TO CITATION(S) 41398, 41399, 41555, 41574

41498 **(AD-A—190111/5/XAB) Animal studies in the mode of action of agents that are antitransformers in cell cultures. Final report, June 1984-August 1987.** Altmann, H. (Oesterreichisches Forschungszentrum Seibersdorf G.m.b.H.). 28 Oct 1987. 114p. NTIS, PC A06/MF A01.

The most important results of the animal studies on the mode of action of the antitransformer DADH on short- and long-term experiments are the following: combined treatment of DADH and gamma-irradiation generated a decreased incidence of malignant lymphoma compared to gamma irradiation alone. DADH itself shows some carcinogenic properties. In short-term experiments DADH has an immunoprotective effect with respect to gamma irradiation: a. earlier reconstitution of lymphocyte subsets, b. increase in natural killer cell activity. Higher poly(ADP-ribose)-polymerase activity to a certain extent seems to control replicative DNA synthesis and specific DNA amplification determined by double minutes. Spleen cells with loss of DNA repair increased remarkably with age. At the same time lymphoma incidence is increasing. Nucleotide sedimentation studies showed an oversedimentation phenomena rather than DNA breaks during short- and long-term experiments. A certain correlation between basic UDS in spleen cells and the occurrance of lymphomas exists. Basic UDS was highest in the combined (gamma + DADH) group. But also, after a single irradiation dose of 1 Gy, basic UDS was elevated during the whole life time. Poly(ADP-ribose)-polymerase activity parallels the poly(ADP-ribose) content in spleen and liver cells at the end of the life span of C57 bl mice.

41499 **(AD-A—190410/1/XAB) For the record - a history of the Nuclear Test Personnel Review program, 1978-1986. Technical report, 21 February 1985-1 August 1986.** Johnson, A.A.; Goetz, J.L.; McRaney, W.K. (Science Applications International Corp., McLean, VA (USA)). 1 Aug 1986. 255p. (SAIC—2-816-00-842-00). NTIS, PC A12/MF A01.

This volume is a history of the Nuclear Test Personnel Review (NTPR) program from 1978 to 1986. It identifies the origins, missions, and historical evolution of the effort, focusing on the contributions of the Defense Nuclear Agency, the NTPR teams, the Veterans Administration, and the Department of Energy. In addition, the narrative describes U.S. nuclear operations, including weapons testing and the atomic bombing of Hiroshima and Nagasaki, Japan, personnel participation in those operations, and radiation safety measures. The report also discusses radiation dose determination and medical studies of potential dose effects.

41500 **(AD-A—191079/3/XAB) Immune-alteration studies in irradiated dogs. Technical report, 1 December 1983-31 October 1986.** Bowles, C.A. (Immuquest Labs., Inc., Fairfax, VA (USA)). 31 Oct 1986. 15p. NTIS, PC A03/MF A01.

The objective of this research work were to 1) serially evaluate the immune function of experimentally manipulated dogs to define the time required to normalize immune function; 2) identify immunologic lesions produced by the experimental protocol which causes a delay in recovery of immune function; and 3) define the method of restoring immune function through the use of immune-enhancing agents.

41501 **(AD-A—191131/2/XAB) Comparison of symptomatology and performance degradation for motion and radiation sickness. Technical report, 6 January 1984-31 March 1985.** McClellan, G.E.; Wiker, S.F. (Pacific-Sierra Research Corp., Arlington, VA (USA). Washington Operations). 31 May 1985. 69p. (PSR NOTE—608). NTIS, PC A04/MF A01.

This report quantifies for the first time the relationship between the signs and symptoms of acute radiation sickness and those of motion sickness. With this relationship, a quantitative comparison is made between data on human performance degradation during motion sickness and estimates of performance degradation during radiation sickness. The comparison validates estimates made by the Intermediate Dose Program on the performance degradation from acute radiation sickness.

41502 **(AD-A—191869/7/XAB) Cognitive performance decrement in US Army aircrews. Technical report, 21 May 1984-31 August 1985.** Peters, J.I.; Archer, M.A.; Moyer, M.J. (Science Applications International Corp., McLean, VA (USA). Human Performance Technology Div.). 31 Aug 1985. 168p. (SAIC—85/1787). NTIS, PC A08/MF A01.

This study investigates the use of subjective estimates to assess the cognitive effects of intermediate doses of radiation on helicopter crew performance. A mission analysis performed across several aircraft with scenarios developed for the CH-47 and AH-1 followed the detailed task analysis and classifications. Thirty-four CH-47 crews performed 9 tasks on a CH-47 simulator and their task times were measured. An analysis was made of the task times including a comparison of actual times against pilot estimates of times for each task. Pilot estimates of radiation effects were analyzed and methods for predicting such estimates are discussed. The primary study recommendation was for validation of questionnaire techniques for predicting radiation-induced performance decrement.

41503 **(CEA-CONF—9224) Clinical study of inhaled aerosols total deposition in healthy adults and children.** Becquemin, M.H.; Roy, M.; Bonnefous, S.; Lafuma, A. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. de Protection Sanitaire). 1986. 8p. (CONF-861123—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88753596/JAW.

From CEC/CEA international workshop on age-related factors in radionuclide metabolism and dosimetry; Angers, France (26 Nov 1986).

Inhalation is the first step towards respiratory tract intake of chemical and radioactive toxics. Particle deposition in human airways has been described by several authors as showing large individual variations. This study intends to contribute to assess this variability limits especially with reference to age. The method used is basically a measurement of retention, by difference between inhaled and exhaled air concentrations, of inert monodispersed aerosols, during controlled breathing. Particles of 1, 2, 3 μm MMAD (polystyrene latex) are measured in size and concentration by laser velocimetry. A Fleish pneumotachograph is used for controlling respiratory parameters. Healthy subjects, male and female, undergo the test at various tidal volumes, frequencies and flow rates, simulated resting and exercising ventilation; their respiratory function is also explored in a very complete way. 20 adults between 23 and 54 years have been tested in order to assess the laboratory reference values. 25 children, 8 under the age of 8 years, and 17 between 8 and 15 years, have been tested in a similar way. Compared to

adults, children, especially under 8 years, have different total deposition mean values, higher for spontaneous and quiet controlled breathing, lower for exercising controlled breathing. Total deposition is dependent on particle size, higher for 2 than for 1 μm MMAD, but also, on lung volume, V.C., T.L.C., F.R.C., to which it is inversely proportional.

41504 (CEA-CONF—9225) Dosimetric lung models. James, A.C.; Roy, M. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Inst. de Protection et de Surete Nucleaire). 1986. 14p. (CONF-861123—). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88753597/JAW.

From CEC/CEA international workshop on age-related factors in radionuclide metabolism and dosimetry; Angers, France (26 Nov 1986).

The anatomical and physiological factors that vary with age and influence the deposition of airborne radionuclides in the lung are reviewed. The efficiency with which aerosols deposit in the lung for a given exposure at various ages from birth to adulthood is evaluated. Deposition within the lung is considered in relation to the clearance mechanisms acting in different regions or compartments. The procedure for evaluating dose to sensitive tissues in lung and transfer to other organs that is being considered by the Task Group established by ICRP to review the Lung Model is outlined. Examples of the application of this modelling procedure to evaluate lung dose as a function of age are given, for exposure to radon daughters in dwellings, and for exposure to an insoluble /sup 239/Pu aerosol. The former represents exposure to short-lived radionuclides that deliver relatively high doses to bronchial tissue. In this case, dose rates are marginally higher in children than in adults. Plutonium exposure represents the case where dose is predominantly delivered to respiratory tissue and lymph nodes. In this case, the life-time doses tend to be lower for exposure in childhood. Some of the uncertainties in this modelling procedure are noted.

41505 (CEA-CONF—9226) Absorption and retention of plutonium in the small intestine of neonate rat. Effects of chemical forms. Moutairou, K.; Fritsch, P.; Beauvallet, M.; Metivier, H.; Masse, R. (CEA Centre d'Etudes de Bruyeres-le-Chatel, 91 (France)). [1988]. 7p. (CONF-861123—). NTIS (US Sales Only), PC A02/MF A01.

From CEC/CEA international workshop on age-related factors in radionuclide metabolism and dosimetry; Angers, France (26 Nov 1986).

Ligated segments of rat intestine were used to study the effect of age on the jejunal transfer and retention of different chemical forms of soluble Pu(IV). After instillation of Pu-carbonate a 5-fold increase of transfer was observed for 1 week old animals as compared to adults. This transfer value decreased gradually until weaning. Such an age-related decrease was also observed after the instillation of Pu-transferrin for 2 weeks as compared to 12 weeks-old rats, but in the same range of age, no significant modification could be demonstrated after the instillation of Pu-DTPA complex. Similar modifications related to the age of animals were observed after either perfusion or instillation of the Pu-carbonate and Pu-DTPA chemical forms. Measurement of the area of the intestinal lumen allowed to establish that, in the jejunum, for the chemical forms of Pu studied, no increase of Pu retention could be observed in neonates as compared to adults. Therefore, no relationship could be established between transfer of Pu and its jejunal retention.

41506 (CNIC—00049) Determination of lymphocyte transformation in patients of various diseases. Su Liaoyuan; Liu Ke Liang; Lin Xingcheng; Sun Guoqi; Xue Zhimou. (China Nuclear Information Centre, Beijing, BJ). 1987. 10p. (In Chinese). (SMC—0002). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702631/JAW.

The synthesis of DNA, RNA and protein during the transformation of human lymphocytes induced by mitogen PHA and LPS was investigated by quantitation of /sup 3/H-TdR, /sup 14/C-UR and /sup 14/C-valine incorporation method. 1666 tests were carried out in patients with various diseases and 424 tests in normal subjects. It was found that immunocompetence was closely related with the progress and prognosis in patients with leukemia. Impairment of the cell-mediated immunity in patients with squamous cell carcinoma and with encephlitis was observed. There was no difference in immunity between patients with adenocarcinoma and the normal subjects. The ionizing irradiation mainly exerts its effect on cell-mediated immunity. The cell-mediated immunity was found to be impaired while the humoral immune regulation was enhanced in tuberculosis and leprosy, indicating that these diseases were caused by impairment of cell-mediated immunity. Both humoral and cell-mediated immunity return to normal levels at convalescence. The uptake of /sup 14/C-UR by lymphocytes in patients with hepatitis increased significantly. Lymphocytes reactivity was elevated in patients with vernal conjunctivities and normal in patients with uveitis. Low reactivity was observed in patients with keratitis. The immunity in various diseases was discussed.

41507 (CNIC—00070) Study of monitoring protection of radionuclides contamination in organism by autoradiography. Zhu Shoupeng; Kang Baoan; He Guangren. (China Nuclear Information Centre, Beijing, BJ). 1987. 10p. (In Chinese). (SMC—0005). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702635/JAW.

In view of the exceptionally important role of the medical radiation protection in human health, the authors try to study on the monitoring of internal contamination of radionuclides in organism by different autoradiographic methods, such as: monitoring of the body retention of isolated or combined radionuclides by freezing microautoradiography; monitoring of blood, bone marrow and excreta radioactive samples by smear autoradiography; differentiation of two radionuclides contamination by double radionuclide autoradiography; especially, monitoring of low level of radionuclides contamination by fluorescence sensitization autoradiography. The sensitivity of autoradiographic formation was increased by the scintillator by 10 times.

41508 (CNIC—00110) Effect of /sup 60/Co γ-rays on con A and LPS induced lymphocytes. Su Liaoyuan; Liu Keliang; Ma Xiangrui. (China Nuclear Information Centre, Beijing, BJ). 1987. 6p. (In Chinese). (SMC—0014). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702636/JAW.

The effect of /sup 60/Co γ-rays on lymphocytes induced by Con A and LPS and the relationship between these two groups of cells were investigated by means of /sup 3/H-TdR incorporation. The study showed that in vitro, Con A cells were able to promote the inducing effect of LPS to B cells. When Con A cells were irradiated by 10 Gy γ-rays, the /sup 3/H-TdR incorporation value reduced significantly and the stimulating effect of Con A cells on LPS cells disappeared. Having been irradiated by γ-rays, LPS cells were not be able to be stimulated by normal Con A cells. When the groups of cells were incubated together after irradiation, the synergistic function disappeared, furthermore the suppressive effect of Con A cells on LPS cells emerged. When these two groups of cells were investigated by means of agar culture, the suppressive effect of 10 Gy γ-rays on lymphocytes colony formation was more obvious. Tests on 7 patients who were suffering from carcinoma of nasoparynx showed that after a course of treatment with /sup 60/Co γ-rays, the incorporation value in Con A cells became much smaller, the stimulating effect of Con A cells on LPS cells disappeared. LPS cells could not be stimulated by normal Con A cells. The study demonstrated that the radiosensitivity of Con A cells is higher than that of LPS cells.

41509 (CNIC—00116) Pathological analysis of 9 cases uranium miners pneumoconiosis. Wu Litian; Cao Guiming; Wu Jiexin; Shi Zhangchen. (China Nuclear Information Centre, Beijing, BJ). 1987. 7p. (In Chinese). (HH—0002). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702637/JAW.

This paper contrasts the pathological staging of pneumoconiosis with clinical staging. Two special kinds of the silicotuberculous nodules were found: The half of a solitary aciner nodule is composed of silicotic nodules, the other tuberculous lesion; The central nodule is caseous pneumonic lesion and the peripheral composition is silicotic nodules. Four kinds of cavity are found in pneumoconiosis: tubercular cavity, silicotic cavity, tuberculosilicosis and mixed pneumoconiosis cavity. Eqithelium changes i.e. hyperplasia,

metaplasia, dysplasia and carcinogenesis are observed on the epithelium of bronchi and alveoli in pneumoconiosis.

41510 **(CNIC—00117) Lung Cancer in uranium miners.** Zhou Chundi; Fan Jixiong; Wang Liuhu; Huang Yiehan; Nie Guanghua. (China Nuclear Information Centre, Beijing, BJ). 1987. 6p. (In Chinese). (HH—0003). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702638/JAW.

This paper analyese the clinical data of 39 uranium miners with lung cancer and of 20 patients with lung cancer who have not been exposed to uranium as control. The age of uranium miners with lung cancer was 36~61 with an average of 48.8, nine years earlier than that of the control group (57.3). In the uranium miner patients the right lung was more susceptible to cancer than the left, the ratio being 2.5:1. However, in the control group the right lung had an equal incidence of cancer as the left lung. The relative frequency of small cell anaplastic carcinoma in uranium miner was higher than that in the control group. In the miner patients the mean occupation history was 11.1 +- 5.2 years; the exposure dose to radon and its daughters in 50% patients was 0.504J(120 WLM). The etiologic factor of lung cancer in uranium miners is strongly attributed, in addition to smoking, to the exposure to radon and its daughters in uranium mines.

41511 **(CONF-870701—Suppl.) Eighth international congress of radiation research: Final programme.** (International Association for Radiation Research, 33 - Bordeaux (France)). 1987. Contract FG03-87ER60499. 177p. NTIS, PC A09/MF A01; 1; GPO Dep. Order Number DE88008624/JAW.

From 8. international congress of radiation research; Edinburgh, UK (19 Jul 1987).

This booklet is the program for the Eighth International Congress of Radiation Research. The booklet lists the titles and authors of each presentation made, organized by sessions.

41512 (CONF-8703182—Summs., pp 94) **Evidence for three types of x-ray damage repair in yeast and sensitivity of totally repair deficient strains to sunlight.** Game, J.C.; Schild, D.; Mortimer, R.K. (Lawrence Berkeley Lab., CA (USA)). 1987. NTIS, PC A07/MF A01. Order Number DE88002817/JAW.

From Conference on cellular molecular aspects, radiation induced DNA damage and repair; Albuquerque, NM, USA (10 Mar 1987).

Mutants of yeast that confer sensitivity to x-rays are known to fall into two epistasis groups, called here the RAD51 and RAD18 groups, which are each thought to control a different type of x-ray repair. They examine here the role of genes in a third repair pathways in x-ray repair. RAD1 and RAD3 are known to be important in the repair of pyrimidine dimers after uv-irradiation. They find that these genes can also play an important role in x-ray repair, but that this role is only exposed when both the other pathways of x-ray repair are blocked. Double mutants blocked in the RAD51 and RAD18 pathways are significantly less x-ray sensitive than triple mutants blocked in these pathways but also mutant in either the RAD1 or RAD3 genes. In a related experiment, they tested the importance of DNA repair in nature by determining the sensitivity to natural unfiltered sunlight of a strain lacking all known DNA repair pathways. They constructed a quadruple mutant strain containing RAD1-1, RAD18-2, RAD51-1 and PHR1-1. The latter mutation blocks the cell's ability to photoreactivate uv damage. They found that this strain was so sensitive to sunlight that less than three seconds' exposure would cause an average of one lethal hit per cell, and survival was less than 2% after ten seconds' exposure. Wild type yeast at sea level showed no killing after thirty minutes. the quadruple mutant is approximately one thousand times more sensitive to sunlight than the related wild type.

41513 (CONF-8703182—Summs., pp 95) **Multiple chromatin breaks from individual high-LET particles.** Goodwin, E.H.; Blakely, E.A.; Tobias, C.A. (Lawrence Berkeley Lab., CA (USA)). 1987. NTIS, PC A07/MF A01. Order Number DE88002817/JAW. Contract AC03-76SF00098.

From Conference on cellular molecular aspects, radiation induced DNA damage and repair; Albuquerque, NM, USA (10 Mar 1987).

The authors have quantitated the distribution of chromatin breaks produced by ionizing radiations in mammalian cells with the technique of premature chromosome condensation (PCC). Plateau phase Chinese hamster ovary cells were irradiated with various doses of X rays, neon, argon, niobium or uranium ion beams accelerated to initial energies of between 400-960 MeV/u and representing LET values from 32-2600 keV/μm. Cells were pretreated with cycloheximide and irradiated at 4°C. Immediately after irradiation the cells were fused to mitotic inducer cells causing premature condensation of the chromatin of the interphase cell. The chromatin fragments from individual cells were scored microscopically. Histograms of the number of chromatin breaks per cell indicated that; (1) at LET values greater than ~ keV/μm single heavy ions produced an average of more than one chromatin break per cell. Multiple chromatin breaks produced by a single particle caused clustering of radiolesions; (2) high LET ions produced distributions of lesions that were not Poissonian; and (3) a form of the Meyman distribution which takes into account the clustering phenomenon fitted the particle data well.

41514 (CONF-8703182—Summs., pp 97) **Determination of strand break repair kinetics in quiescent and cycling human peripheral blood lymphocytes.** Jostes, R.F.; Reese, J.A.; Morris, J.E. (Pacific Northwest Lab., Richland, WA (USA)). 1987. NTIS, PC A07/MF A01. Order Number DE88002817/JAW. Contract AC06-76RL01830.

From Conference on cellular molecular aspects, radiation induced DNA damage and repair; Albuquerque, NM, USA (10 Mar 1987).

Fluorometric elution techniques are being used to measure strand break repair kinetics in quiescent and cycling human peripheral blood lymphocytes. In the initial investigations, ^{60}Co served as a reference radiation source. Preliminary data indicate that single strand breaks (SSB) are repaired slower in quiescent (G) lymphocytes. In both cases, the response is biphasic and the breaks are completely repaired with time. Preliminary results with double strand breaks (DBS) in quiescent lymphocytes indicate that the repair is slower than that seen for SSB (G_0 lymphocytes). Longer time intervals will be required to establish whether a fraction of the DSB are left unrepaired in both lymphocyte populations. They intend to employ these techniques to investigate repair kinetics and residual damage levels after exposure to radon daughters and other particulate radiation using quiescent and cycling human cells. Experiments have also been initiated to investigate possible adaptive effects using these techniques.

41515 (CONF-8703182—Summs., pp 98) **Evidence for elevated somatic cell mutations at the glycophorin A locus in atomic bomb survivors.** Langlois, R.G.; Bigbee, W.L..; Akiyama, M.; Jensen, R.H. (Lawrence Livermore National Lab., CA (USA)). 1987. NTIS, PC A07/MF A01. Order Number DE88002817/JAW. Contract W-7405-ENG-48.

From Conference on cellular molecular aspects, radiation induced DNA damage and repair; Albuquerque, NM, USA (10 Mar 1987).

An assay system for in vivo human somatic cell mutations has been used to study survivors of the atomic bomb at Hiroshima. This assay utilizes fluorescently labeled monoclonal antibodies and flow cytometry to measure the frequency of human erythrocytes that fail to express one allelic form of the cell surface protein glycophorin A (GPA), presumably due to null mutations in erythroid precursor cells. Significant linear correlations between variant frequency (VF) and radiation dose were observed for three different variant cell phenotypes. The spontaneous and induced VFs from this study agree well with measures of radiation-induced mutagenesis in other systems, supporting a mutational origin for GPA-loss variant cells and suggesting that the GPA system may provide a cumulative dosimeter of past radiation exposures. VFs for some individual survivors that were heavily exposed differed dramatically from the calculated dose response suggesting that substantial stem cell kill may affect the recording of induced mutations.

41516 (CONF-8703182—Summs., pp 99) **Elevated epidermal growth factor (EGF) receptor bindings in dog lung tumors.** Leung, F.C.; Bohn, L.R. (Pacific Northwest Lab., Richland, WA (USA)). 1987. NTIS, PC A07/MF A01. Order Number DE88002817/JAW. Contract AC06-76RL01830.

From Conference on cellular molecular aspects, radiation induced DNA damage and repair; Albuquerque, NM, USA (10 Mar 1987).

The objective of this study is to measure and characterize epidermal growth factor (EGF) receptor binding in dog Pu induced in lung-tumor tissue and to compare then with normal lung tissue in dogs. Epidermal growth factor and its receptors have been shown to play an important role in the proliferation and differentiation of eukaryotic cells. It was therefore hypothesized that inappropriate activation of EGF receptor plays a role in oncogenesis. Microsomal preparations prepared from normal and lung-tumor tissue from beagle dogs were used in a radioreceptor assay, using ^{125}I-EGF as a ligand. Specific EGF receptor bindings were determined in the presence of excess unlabeled EGF. They have examined EGF receptor bindings in 10 lung-tumor samples obtained from seven dogs at necropsy. Epidermal growth factor receptor bindings were significantly higher in eight of the lung-tumor samples compared with both normal lung tissue from control dogs and normal lung tissue from dogs from which tumors were obtained. Their results suggest that the high EGF receptor bindings observed in lung-tumor tissue may play a role in the oncogenesis in dogs.

41517 (CONF-8703182—Summs., pp 100) **Modulation of radiation-induced chromosome aberrations by DMSO-preliminary comparisons in three mammalian species.** Littlefield, L.G.; Frome, E.L.; Joiner, E.E.; Colyer, S.P. (Oak Ridge Associated Universities, TN (USA)). 1987. NTIS, PC A07/MF A01. Order Number DE88002817/JAW. Contract AC05-76OR00033.

From Conference on cellular molecular aspects, radiation induced DNA damage and repair; Albuquerque, NM, USA (10 Mar 1987).

Earlier, the authors exposed human lymphocytes to X-radiation in medium containing DMSO. Objectives were to estimate the contribution of reactive radical species in inducing DNA lesions involved in the formation of chromosome aberrations. To determine whether DMSO was equally effective in protecting against exchange induction in lymphocytes of other mammalian species, they exposed human, pig, and rabbit lymphocytes to 99, 191, or 383 rad X-rays in medium with or without 1 M DMSO. Evaluations of induced dicentrics in M(I) metaphases from cultures without DMSO demonstrated differences in relative radiation sensitivity between the three species as expected. Pronounced, species-dependent reductions in X-ray induced dicentrics were observed in lymphocytes irradiated in the presence of DMSO.

41518 (CONF-8703182—Summs., pp 101) **Isolation of human DNA sequences associated with a DNA excision repair gene.** MacInnes, M.A.; Okinaka, R.T.; Chen, D.J.; Reynolds, R.J.; Tesmer, J.G.; Strniste, G.F. (Los Alamos National Lab., NM (USA)). 1987. NTIS, PC A07/MF A01. Order Number DE88002817/JAW.

From Conference on cellular molecular aspects, radiation induced DNA damage and repair; Albuquerque, NM, USA (10 Mar 1987).

The authors approach to obtain a molecular understanding of mammalian DNA repair for UV-DNA damage has focused on the isolation of a human gene that complements the CHO cell mutant UV-135. They used serial $CaPO_4$-mediated DNA cotransformations to isolate UV-resistant transformants containing few copies of plasmid pSV2 ligated to human genomic DNA fragments. Tertiary transformants have about three copies of pSV2 that are co-inherited with the repair competent phenotype. These sequences and some flanking DNA were cloned by plasmid rescue and showed positive hybridization for human specific repetitive DNA sequences. They have now begun screening cosmid libraries constructed in vector pHC79. Cosmids containing the amplified gpt gene segment and/or strongly hybridizing human-specific repetitive DNA have been isolated and partially ordered into a physical map of human sequences putatively associated with the repair gene. These cloned sequences are being tested first for functional activity when transfected into UV-135; second, for their human chromosomal origin; and third, for the capacity of certain non-repetitive DNA fragments to hybridize with purified messenger RNA by Northern blot analysis.

41519 (CONF-8703182—Summs., pp 102) **Computer simulation of damage induced in DNA by radiation with high linear energy transfer.** Miller, J.H.; Wilson, W.E.; Swenberg, C.E.; Charlton, D.E. (Pacific Northwest Lab., Richland, WA (USA)). 1987. NTIS, PC A07/MF A01. Order Number DE88002817/JAW. Contract AC06-76RL01830.

From Conference on cellular molecular aspects, radiation induced DNA damage and repair; Albuquerque, NM, USA (10 Mar 1987).

The molecular nature of primary lesions in DNA is important for an understanding of cellular responses to radiation exposure and their dependence on dose, dose rate, and radiation quality. Full characterization of the physicochemical alterations induced by absorption of radiation in mammalian chromatin will ultimately require a much larger data base of interaction probabilities and reaction rates than is presently available; however, progress can be made on the basis of their current understanding of spatial patterns of energy deposition by ionizing radiation and their geometric relation to chromatin structure. Since energy transfer from radiation to matter is a stochastic process, research in this area generally involves (i) computer simulation by Monte Carlo techniques of the slowing down of ions and electrons in biologically relevant materials, (ii) scoring energy deposited in well-defined volumes that model the elements of chromatin structure, and (iii) mathematical models of the chemical and biological changes induced by the absorbed energy. These techniques have been successfully employed to predict the yield of free radicals in oriented fibers of DNA by exposure to neutrons and the production of single- and double-strand breaks in DNA by ^{125}I decays.

41520 (CONF-8703182—Summs., pp 103) **Modulation of DNA synthesis and cell killing by deoxycytidine in a radiation-sensitive CHO cell line.** Newman, C.N.; Miller, J.H.; Poston, K.A. (Pacific Northwest Lab., Richland, WA (USA)). 1987. NTIS, PC A07/MF A01. Order Number DE88002817/JAW. Contract AC06-76RL01830.

From Conference on cellular molecular aspects, radiation induced DNA damage and repair; Albuquerque, NM, USA (10 Mar 1987).

DNA synthesis in the hamster cell line CHO-Kl and a radiation-sensitive mutant, was examined and compared. Unirradiated cells were pulse-labeled with [^{3}H] TdR for 5 minutes then permitted to grow in the absence of label for various periods. Alkaline-sucrose gradient profiles of labeled DNA were obtained and from these profiles, rates of DNA chain elongation/maturation were determined for both cell lines. Synthesis in the xrs-5 mutant was several-fold faster than in the parent CHO-Kl cell line. Addition of 2 mM deoxycytidine (CdR) to the culture medium of xrs-5 decreased the rate of DNA replication in the mutant to a level comparable with the parent cell and concurrently increased the resistance of the mutant to killing by uv light to a value similar to the parent cell line. The modulation of both replication and resistance to radiation by the presence of CdR in the growth medium suggest that the genetic locus that is sensitizing xrs-5 is related to the DNA replication complex.

41521 (CONF-8703182—Summs., pp 104) **Radiobiological characterization of human P3 teratocarcinoma cells: survival and DNA damages.** Peak, M.J. (Argonne National Lab., IL (USA)). 1987. NTIS, PC A07/MF A01. Order Number DE88002817/JAW.

From Conference on cellular molecular aspects, radiation induced DNA damage and repair; Albuquerque, NM, USA (10 Mar 1987).

An attempt has been made to characterize the lethal effects on P3 teratocarcinoma cells of ^{60}Co gamma-rays, 50 kVp x-rays, and JANUS fission-spectrum neutrons and compared these data with those that were obtained with the extensively studied Chinese hamster lung fibroblast V79 line. For cell killing, the authors found no differences between x-ray and Y-ray response in either line, but P3 cells are about twice as sensitive as V79 cells to both of these

radiations. For neutrons, P3 cells are 1.6 times as sensitive as V79 cells. Both types of cells are killed more efficiently by neutrons than by x-rays with relative biological effectiveness (RBEs) of about 6.3 for V79 cells and 3.6 for P3 cells. To investigate the molecular basis for the high lethality of JANUS neutrons in the P3 cells, they compared the yields of DNA breaks and DNA-to-protein crosslinks caused by JANUS fission-spectrum neutrons, with yields produced by x-rays, gamma-rays, and nonionizing radiation. With regard to breaks, the yields obtained after x-rays and gamma-rays were identical. The RBE for DNA breakage for JANUS neutrons was about 8 relative to x-rays, 70 breaks per genome per lethal event. This finding provides evidence that lesions other than those measured so far are important in the killing of cells by neutrons.

41522 (CONF-8703182—Summs., pp 106) **Further studies of the UV-induced 313 NM photosensitive DNA lesion which is not repaired in xeroderma pigmentosum variants.** Regan, J.D.; Francis, A.A. (Oak Ridge National Lab., TN (USA)). 1987. NTIS, PC A07/MF A01. Order Number DE88002817/JAW. Contract AC05-84OR21400.

From Conference on cellular molecular aspects, radiation induced DNA damage and repair; Albuquerque, NM, USA (10 Mar 1987).

The authors have previously shown the existence of a UV-inducible lesion in the DNA of human cells which is sensitive to irradiation with large doses of 313 nm light resulting in strand breaks that are resolvable on alkaline sucrose gradients. The lesions generated by 20 J/m² of 254 nm light are repaired in normal cells in 3 to 5 hours but are not repaired in excision repair deficient xeroderma pigmentosum (XP) group A cells or in excision proficient XP-variant cells. This lesion might, therefore, help explain the cancer prone nature of the XP-variant individuals. Experiments have shown that the production of the lesions by 254 nm irradiation is independent of temperature which indicates a photodynamic and not an enzymatic or chemical reaction is involved in formation of the lesions. The disappearance of the lesion from the DNA, however, is temperature dependent and probably enzymatic. In an attempt to learn more about the nature of the lesion, the spectra of the lesion's formation and its photolysis were measured.

41523 (CONF-8703182—Summs., pp 108) **Cell survival studies using ultrasoft x rays.** Schillaci, M.E.; Raju, M.R.; Carpenter, S.; Cornforth, M.; Wilder, M. (Los Alamos National Lab., NM (USA)). 1987. NTIS, PC A07/MF A01. Order Number DE88002817/JAW.

From Conference on cellular molecular aspects, radiation induced DNA damage and repair; Albuquerque, NM, USA (10 Mar 1987).

Cell survival was studied for V79 hamster, 10T1/2 mouse, and human skin fibroblast cell lines, using carbon K (0.28 keV), copper K (8.0 keV), and 250 kVp x rays. Because of the rapid attenuation of the carbon x rays, cellular dimensions at the time of exposure were measured using optical and electron microscopy, and frequency distributions of mean dose absorbed by the cell nucleus were obtained. The results indicate that the differences in cell killing between ultra-soft and hard x rays may depend on the nuclear thickness of the cells. Studies of the effects of hypoxia on V79 and 10T1/2 cells using carbon K, aluminum K (1.5 keV), and copper K x rays show decreasing OER values with decreasing x-ray energy and no difference between the two cell lines. Age response studies with V79 cells show similar cell-cycle variation of survival for carbon K and aluminum K x rays as for hard x rays.

41524 (CONF-8703182—Summs., pp 109) **Chronic radiation-induced leukemogenesis: alterations of hematopoietic progenitor repair functions during preclinical phases.** Seed, T.M.; Kaspar, L.V.; Grdina, D.J.; Frazier, M.E. (Argonne National Lab., IL (USA)). 1987. NTIS, PC A07/MF A01. Order Number DE88002817/JAW. Contract W-31-109-ENG-38.

From Conference on cellular molecular aspects, radiation induced DNA damage and repair; Albuquerque, NM, USA (10 Mar 1987).

Chronic exposure to low daily doses of whole-body gamma irradiation elicits a high incidence of myeloid leukemia (ML) and related myeloproliferative diseases (MPD) in beagles. Previously, the authors identified and partially characterized a four-phase sequence of evolving MPD as a consequence of chronic radiation exposure. With a focus on preclinical alterations in granulocyte/monocyte-committed stem cells, they have identified two critical events in the process: (i) an early event, involving the coupling of acquired radioresistance of the stem cell with renewed proliferative capacity; and (ii) a late event, involving acquired autocrine functions and associated change in stem cell clonality. In terms of the early event, repair-associated parameters are currently being examined on the cellular level by both split-dose and low dose-rate-type assays with survival enhancement used as the measured end point. On the molecular level, these parameters are examined by microfluorometric alkaline elution assays with DNA damage and repair used as end points.

41525 (CONF-8703182—Summs., pp 110) **Use of a shuttle plasmid to study mutations in human cells by ionizing radiation.** Sikpi, M.O.; Gooch, P.C.; Preston, R.J.; Mitra, S. (Oak Ridge National Lab., TN (USA)). 1987. NTIS, PC A07/MF A01. Order Number DE88002817/JAW. Contract AC05-84OR21400.

From Conference on cellular molecular aspects, radiation induced DNA damage and repair; Albuquerque, NM, USA (10 Mar 1987).

The nature of mutagenic changes induced by ionizing radiation in human cells is being studied in a SV40-based shuttle plasmid pZ 189 containing E. coli supF-tRNA as the target gene. The mutant plasmids are detected by phenotypic screening of the plasmid-bearing bacteria and the mutations in the tRNA gene identified by direct sequencing of the recovered plasmid. The whole plasmid, the tRNA gene fragment, or a segment of it are irradiated in vitro before introduction of the plasmid into human cells. Preliminary results show mutations in about 4% of the reconstituted plasmids containing X-irradiated (5 Gy) tRNA gene fragments following their replication in E. coli. Two independent isolates among the mutants had the same C->G transversion. X-ray induced chromosome aberrations in the lymphoblastoid cells are also analyzed in order to compare genomic changes at the molecular and microscopic levels. A linear increase in aberrations was observed in G_2-irradiated cells.

41526 (CONF-8703182—Summs., pp 113) **Transformation of rat tracheal epithelial cells in culture by chemicals and radiation.** Thomassen, D.G.; Maio, S.M. (Lovelace Inhalation Toxicology Research Institute, Albuquerque, NM (USA)). 1987. NTIS, PC A07/MF A01. Order Number DE88002817/JAW. Contract AC04-76EV01013.

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A serum-free culture system has previously been described for the proliferation of rat tracheal epithelial (RTE) cells at clonal density. Using this culture system, preneoplastic variants of RTE cells can be induced following exposure of normal RTE cells to carcinogens. Selection for variants is imposed after carcinogen treatment by switching cultures from serum-free medium which is permissive for the proliferation of normal RTE cells to serum-containing medium which is permissive only for preneoplastic enhanced growth (EG) variants and results in the terminal squamous differentiation of normal RTE cells. EG variants continue to proliferate in serum-containing selective medium forming large colonies of small cells with increased nuclear to cytoplasmic ratios which appear hyperchromatic after staining. Using colony forming assays, RTE cells exhibit a dose-dependent decrease in survival following exposure to direct acting chemical carcinogens such as N-methyl-N'-nitro-N-nitrosoguanidine (MNNG) and benzo[a]pyrene diolepoxide (BPDE) and in response to radiation such as gamma rays or X-rays.

41527 (CONF-8703182—Summs., pp 114) **Cloning and characterization of a human gene which complements the nucleotide-excision-repair-deficient CHO cell line UV5.** Weber, C.A.; Salazar, E.P.; Stewart, S.A.; Thompson, L.H. (Lawrence Livermore National Lab., CA (USA)). 1987. NTIS, PC A07/MF A01. Order Number DE88002817/JAW. Contract W-7405-ENG-48.

From Conference on cellular molecular aspects, radiation induced DNA damage and repair; Albuquerque, NM, USA (10 Mar 1987).

The UV sensitive Chinese hamster ovary (CHO) cell line UV5, which is defective in the incision step of nucleotide-excision-repair, was used to identify a human gene that corrects this repair deficiency and to study the repair process. Four repair proficient, gpt-expressing primary transformants were obtained by cotransforming UV5 cells with the plasmid pSV2gpt and DNA from a human/hamster hybrid line sheared to <50 kb. One secondary transformant (5T4-1) was obtained by transforming UV5 with DNA from a primary transformant sheared to < 50 kb and selecting for both UV resistance and gpt function. Cosmid clones containing the correcting human gene were isolated by screening a cosmid library made from 5T4-1 DNA using HeLa DNA as the probe. In the primary screening, 1.1 million colonies were screened, and 70 cosmids containing human sequences were identified. Of those 70, 21 were purified by secondary and tertiary screening. Transformation of UV5 cells with these cosmid DNAs demonstrated that 8 have a functional repair gene and 6 of those also have a functional gpt gene, reflecting the linkage of these two genes in 5T4-1. UV survival curves demonstrate that primary, secondary, and cosmid transformants have, in all but one case, similar or slightly higher levels of UV resistance compared to normal cells (AA8).

41528 (CONF-8703182—Summs., pp 115) **Pre-exposure of human lymphocytes to 1 cGy (1 rad) of x rays halves the amount of chromosome damage induced by subsequent high dose exposures.** Wolff, S. (Univ. of California, San Francisco (USA)). 1987. NTIS, PC A07/MF A01. Order Number DE88002817/JAW.

From Conference on cellular molecular aspects, radiation induced DNA damage and repair; Albuquerque, NM, USA (10 Mar 1987).

This adaptive response to ionizing radiation, which occurs after exposures that are so low (1 cGy) that they do not induce any aberrations themselves, has been attributed to the induction of a repair mechanism that causes the restitution of X-ray-induced chromosome breaks. It has now been found that the induction occurs when cells are exposed to 1 rad in G_1, S, or G_2, but not G_0. A period of 3-4 hours is required for full induction to occur. Furthermore, once the system has been induced, it lasts for at least 3 cell cycles. Experiments also were carried out to see if the repair mechanism induced by low dose irradiation can affect different types of clastogenic lesions induced in DNA by subsequent exposures to chemical mutagens and carcinogens. Lymphocytes were exposed to mitomycin C, a crosslinking agent, bleomycin, which induces double strand breaks in DNA, and MMS, which alkylates DNA and then leads to single strand breaks. When pre-exposed cells were challenged with high doses of bleomycin or mitomycin C, approximately half as many chromatid breaks were induced as expected. When the cells were challenged with MMS, however, approximately twice as much damage was found than was induced by MMS alone.

41529 (CONF-8703182—Summs., pp 116) **Rearrangement of endogenous ecotropic proviral gene and interleukin-3 gene in radiation-induced myeloid leukemias of RFM/Un mice.** Yang, W.K.; Boone, L.R.; Tennant, R.W.; Goebel, S.; Yang, D.M.; Nikbakht, K.N. (Oak Ridge National Lab., TN (USA)). 1987. NTIS, PC A07/MF A01. Order Number DE88002817/JAW. Contract AC05-84OR21400.

From Conference on cellular molecular aspects, radiation induced DNA damage and repair; Albuquerque, NM, USA (10 Mar 1987).

With the consideration that RFM/Un mice harbor on their chromosome 5 an ecotropic provirus locus for producing murine leukemia viruses (e-MuLV) and that interleukin-3 (IL-3) plays important roles in the growth and differentiation regulation of hematopoietic cells, particularly the myeloid lineages, they have examined radiation-induced myeloid leukemias of these mice for possible alterations in these two genes. Southern gel blot in combination with restriction enzyme analyses were performed with the use of an ecotropic env-specific sequence and an IL-3 cDNA clone as molecular probes. It was found that the transplantable Upton myeloid leukemia line has lost the chromosome 5 (germline) provirus and, instead, contains at least 4 copies of e-MuLV proviral sequences that have been acquired apparently by somatic re-integration. DNA preparations from 4 leukemic spleens of X-irradiated RFM/Un male mice, diagnosed histologically to have developed myeloid leukemias, were therefore examined; all four showed no loss of the germline e-MuLV copy and two of the four contained additional somatically re-integrated e-MuLV proviruses.

41530 (CONF-8703182—Summs., pp 18-28) **Radiation-induced DNA lesions.** Wheeler, K.T.; Lesiak, K.B. (Bowman Gray School of Medicine, Winston-Salem, NC (USA)). 1987. NTIS, PC A07/MF A01. Order Number DE88002817/JAW. Contract FG05-86ER60464.

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Although it has been known for decades that ionizing radiation can cause mammalian cells to die, mutate or transform, relatively little is known about the exact mechanisms responsible for these biological phenomena. In this report, they describe: (1) the development of HPLC methodology with improved sensitivity for the detection of radiation-induced DNA damage products, (2) the use of this methodology to determine the influence of DNA sequence, conformation and oxygen status on the spectrum and quantity of specific lesions produced by ionizing radiation and (3) methodology for isolating and digesting cellular DNA to nucleosides suitable for DNA damage and repair studies. With this information, a number of important questions are now addressable.

41531 (CONF-8703182—Summs., pp 29-32) **Changes in DNA base sequence induced in mutagenesis by ionizing radiation.** Hutchinson, F. (Yale Univ., New Haven, CT (USA)). 1987. NTIS, PC A07/MF A01. Order Number DE88002817/JAW.

From Conference on cellular molecular aspects, radiation induced DNA damage and repair; Albuquerque, NM, USA (10 Mar 1987).

This article summarizes the information available at present on the changes in DNA base sequence induced by ionizing radiation of low LET, which induces both point mutations of various sorts and gross rearrangements of the DNA.

41532 (CONF-8703182—Summs., pp 45) **Pre-exposure of human lymphocytes to a cGy (1 rad) of X rays halves the amount of chromosome damage induced by subsequent high dose exposures.** Wolff, S. (Univ. of California, San Francisco (USA)). 1987. NTIS, PC A07/MF A01. Order Number DE88002817/JAW.

From Conference on cellular molecular aspects, radiation induced DNA damage and repair; Albuquerque, NM, USA (10 Mar 1987).

This adaptive response to ionizing radiation, which occurs after exposures that are so low (1 cGy) that they do not induce any aberrations themselves, has been attributed to the induction of a repair mechanism that causes the restitution of X-ray-induced chromosome breaks. It has now been found that the induction occurs when cells are exposed to 1 rad in G_1, S, or G_2, but not G_0. A period of 3-4 hours is required for full induction to occur. Furthermore, once the system has been induced, it lasts for at least 3 cell cycles. Experiments also were carried out to see if the repair mechanism induced by low dose irradiation can affect different types of clastogenic lesions induced in DNA by subsequent exposures to chemical mutagens and carcinogens. Lymphocytes were exposed to mitomycin C, a crosslinking agent, bleomycin, which induces double strand breaks in DNA, and MMS, which alkylates DNA and then leads to single strand breaks. When pre-exposed cells were challenged with high doses of bleomycin or mitomycin C, approximately half as many chromatid breaks were induced as expected. When the cells were challenged with MMS, however, approximately twice as much damage was found than was induced by MMS alone.

41533 (CONF-8703182—Summs., pp 46-50) **Radiation-induced DNA damage and repair in cell transformation.** Yang, T.C.; Tobias, C.A. (Lawrence Berkeley Lab., CA (USA)). 1987. NTIS, PC A07/MF A01. Order Number DE88002817/JAW. Contract AC03-76SF00098.

From Conference on cellular molecular aspects, radiation induced DNA damage and repair; Albuquerque, NM, USA (10 Mar 1987).

It is well known that high-LET radiations have higher carcinogenic potencies than low-LET radiation. They have used X rays and a variety of monoenergetic particle beams to study the mechanisms of neoplastic cell transformation in vitro. The LET of fast heavy nuclei is proportional to the square of the electric charge of the particles and inversely proportional to their velocity. Their conclusions are that there are great similarities in the relationship between RBE and LET for radiation-induced cell transformation, chromosome mutation and lethal effects. Individual heavy ions are capable of producing clusters of lesions in DNA and in chromatin, and the essential steps in the transformation process may relate to misrepair and to incomplete repair of such lesions. Nonhomologous repair appears to have an important role in the cell transformation process; their current investigations are directed at isolating this process and characterizing its molecular parameters.

41534 (CONF-8703182—Summs., pp 55-58) **Overview of the role of oncogenes in radiation induced carcinogenesis: oncogenes as potential molecular markers of radiation damage.** Frazier, M.E. (Pacific Northwest Lab., Richland, WA (USA)). 1987. NTIS, PC A07/MF A01. Order Number DE88002817/JAW. Contract AC06-76RL01830.

From Conference on cellular molecular aspects, radiation induced DNA damage and repair; Albuquerque, NM, USA (10 Mar 1987).

Not all DNA damage results in cancer, existing evidence implicates a subset of cellular genes in carcinogenesis. These genes (proto-oncogenes) which are important for normal growth and development, are growth factors, receptors for growth factors, transducers within the cell that can alter a signal by phosphorylation of proteins or other devices, and nuclear effectors that respond to mitogenic signals. Studies have shown that proto-oncogenes can be activated to become oncogenes by genetic alterations which result from point mutations, translocations, deletions, amplifications or other genetic mechanisms. This activation results either in an altered protein with a modified function, increased amounts of gene product, or some combination of these events. Such changes in the biochemical activities of oncogenes can perturb the way in which signals from outside the cell are processed. These changes result in altered cellular activities and/or abnormal cell division, each of which can contribute to the carcinogenic process. The idea that proto-oncogene activation is an important event in the generation of neoplastic disease is supported by the relationship between chromosome abnormalities observed in cancer cells and proto-oncogene activation.

41535 (CONF-8703182—Summs., pp 59-60) **Oncogene activation in radiation-induced rat skin tumors.** Burns, F.J.; Sawey, M.J.; Garte, S.J. (New York Univ. Medical Center, NY (USA)). 1987. NTIS, PC A07/MF A01. Order Number DE88002817/JAW.

From Conference on cellular molecular aspects, radiation induced DNA damage and repair; Albuquerque, NM, USA (10 Mar 1987).

A sample of 12 radiation-induced skin tumors were tested for oncogene activation. Hybridization of the original rat tumor DNA's revealed evidence for c-myc gene amplification and extensive restriction enzyme polymorphisms in 10 of the 12 tumors following digestion with Eco R1, Hind II, and Bam HI. Rehybridization of the filters using probes for the first exon of c-myc, N-myc (first or second exons), v-able and v-myb, showed no differences in band intensity or restriction fragment pattern between tumors and normal rat DNA. Each of 3 clear cell carcinomas, an aggressive, rapidly growing tumor, exhibited activation of both ras and myc oncogenes, while myc alterations alone were observed in 4 out of 5 squamous cell carcinomas. The finding of concurrent multiple oncogene activation is radiation-induced primary tumors provides evidence in favor of the hypothesis that activation of multiple oncogenes contributes to carcinogenesis by ionizing radiation. The mechanism of activation of the c-myc gene (rearrangements and amplification) may reflect the consequences of radiation acting to break the DNA in specific ways.

41536 (CONF-8703182—Summs., pp 61-64) **Cellular control of ras oncogene action.** Yang, W.K.; Gardner, M.J.; Yang, D.M.; Bassin, R.H.; Myer, F.E.; Ch'ang, L.Y. (Oak Ridge National Lab., TN (USA)). 1987. NTIS, PC A07/MF A01. Order Number DE88002817/JAW. Contract AC05-84OR21400.

From Conference on cellular molecular aspects, radiation induced DNA damage and repair; Albuquerque, NM, USA (10 Mar 1987).

Significant progress has been made in the past several years with the application of the concepts and technology of molecular biology in studying specific genes and gene regulatory functions related to cancers. In particular, the finding of certain transforming human cancer genes being the homologs of oncogenes transduced in acute transforming retroviruses has opened up a new area for molecular genetic study of environmental carcinogenesis, including that caused by radiation. Since carcinogenesis is generally thought to be a multi-factor/multi-step process, it is possible that alteration of an oncogene may represent one important step while other genetic factors may also be involved in the carcinogenesis process. Here they briefly describe their studies to implicate the existence of genetic factor(s) that inhibit the oncogenic action of mutated ras oncogenes and also to demonstrate how this may be exploited for investigating the mechanism of carcinogenesis.

41537 (CONF-8703182—Summs., pp 70-74) **Cloning and characterization of human DNA repair genes.** Thompson, L.H.; Brookman, K.W.; Weber, C.A.; Salazar, E.P.; Stewart, S.A.; Carrano, A.V. (Lawrence Livermore National Lab., CA (USA)). 1987. NTIS, PC A07/MF A01. Order Number DE88002817/JAW. Contract W-7405-ENG-48.

From Conference on cellular molecular aspects, radiation induced DNA damage and repair; Albuquerque, NM, USA (10 Mar 1987).

The isolation of two addition human genes that give efficient restoration of the repair defects in other CHO mutant lines is reported. The gene designated ERCC2 (Excision Repair Complementing Chinese hamster) corrects mutant UV5 from complementation group 1. They recently cloned this gene by first constructing a secondary transformant in which the human gene was shown to have become physically linked to the bacterial gpt dominant-marker gene by cotransfer in calcium phosphate precipitates in the primary transfection. Transformants expressing both genes were recovered by selecting for resistance to both UV radiation and mycophenolic acid. Using similar methods, the human gene that corrects CHO mutant EM9 was isolated in cosmids and named XRCC1 (X-ray Repair Complementing Chinese hamster). In this case, transformants were recovered by selecting for resistance to CldUrd, which kills EM9 very efficiently. In both genomic and cosmid transformants, the XRCC1 gene restored resistance to the normal range. DNA repair was studied using the kinetics of strand-break rejoining, which was measured after exposure to ^{137}Cs γ-rays.

41538 (CONF-8703182—Summs., pp 82-84) **Human gene for repair of damage from ionizing radiation.** Chen, D.J.; Jeggo, P.A.; MacInnes, M.A.; Reynolds, R.J.; Strniste, G.F.; Tesmer, J.G. (Los Alamos National Lab., NM (USA)). 1987. NTIS, PC A07/MF A01. Order Number DE88002817/JAW.

From Conference on cellular molecular aspects, radiation induced DNA damage and repair; Albuquerque, NM, USA (10 Mar 1987).

The repair of radiation-induced DNA damage is a complicated process and presumably a large number of gene products are involved in the repair of different types of damage. Recent studies from their and other laboratories have shown at least 6 complementation groups involved in ionizing radiation-sensitive rodent mutants. Identification and cloning of these human genes are essential for understanding the mechanisms of reparation of radiation-induced DNA damage in man.

41539 (CONF-8703182—Summs., pp 87) **Cloning of a postreplication repair gene in Drosophila.** Banga, S.S.; Yamamoto, A.H.; Mason, J.M.; Boyd, J.B. (Univ. of California, Davis, (USA)). 1987. NTIS, PC A07/MF A01. Order Number DE88002817/JAW.

From Conference on cellular molecular aspects, radiation induced DNA damage and repair; Albuquerque, NM, USA (10 Mar 1987).

Mutants at the mei-41 locus in Drosophila are strongly hypersensitive to each of eight tested mutagens. Mutant flies exhibit reduced meiotic recombination and elevated levels of chromosomal aberrations. In analogy with the defect in xeroderma pigmentosum variant cells, mei-41 cells are strongly defective in postreplication repair following UV radiation. In preparation for cloning that gene they have performed complementation studies between chromosomal aberrations and mei-41 mutants. That study has localized the mei-41 gene to polytene chromosome bands 14C4-6. A chromosomal walk conducted in that region has recovered about 65 kb of contiguous DNA sequence. The position of the mei-41 gene within that region has been established with the aid of a mutation in that gene which was generated by the insertion of a transposable element. Transcription mapping is being employed to define the complete coding region of the gene in preparation for investigations of gene function.

41540 (CONF-8703182—Summs., pp 88) **Induction and repair of radiation- and chemically-induced mutations in CHO cells.** Brooks, A.L.; Seiler, F.A. (Lovelace Inhalation Toxicology Research Institute, Albuquerque, NM (USA)). 1987. NTIS, PC A07/MF A01. Order Number DE88002817/JAW. Contract AC04-76EV01013.

From Conference on cellular molecular aspects, radiation induced DNA damage and repair; Albuquerque, NM, USA (10 Mar 1987).

The frequency of radiation- and chemically-induced mutations was determined in CHO cells at the HGPRT locus. Radiation exposure before indirect acting chemical mutagens B(a)P, DBC, 3-MC or the direct acting mutagen MNNG produced fewer mutations than predicted by an additive model. Exposure-response surfaces were generated for both the indirect acting 3-MC and the direct acting MNNG given alone and in combination with graded levels of radiation. The data demonstrated a negative interactive term for the 3-MC. For the MNNG the best fit for the data has not been determined. However, exposure to radiation after MNNG decreased the mutagenic response at doses as low as 10 rads in a non-dose related manner. The decrease in predicted response was postulated to be related to radiation-induced alterations in the cells which increased repair of genetic damage.

41541 (CONF-8703182—Summs., pp 89) **Use of orthogonal field alternational gel electrophoresis (OFAGE) for studying DNA double strand breakage and repair.** Contopoulou, C.R.; Cook, V.; Mortimer, R.K. (Univ. of California, Berkeley (USA)). 1987. NTIS, PC A07/MF A01. Order Number DE88002817/JAW.

From Conference on cellular molecular aspects, radiation induced DNA damage and repair; Albuquerque, NM, USA (10 Mar 1987).

The study of DNA double strand breakage and repair has normally been carried by using neutral sucrose gradient or neutral elution techniques. The authors have applied OFAGE procedures to study x-ray induced double strand breaks and repair. Breakage of chromosomes is seen by a decrease in intensity of individual chromosome bands; as expected, this decrease becomes more pronounced as chromosome size increases. The fragments of broken chromosomes appears as a broad smear in the size range 100 kb to 1000 kb. Following repair, these fragments partially disappear and the chromosomal bands increase in intensity. In four repair deficient mutants, rad51, rad52, rad54, rad55, no increase in chromosomal band intensity was seen. These results have been confirmed by blotting for a specific chromosome.

41542 (CONF-8703182—Summs., pp 91) **Radiation DNA damage in resting oocytes: super-repaired or masked?.** Dobson, R.L.; Straume, T.; Kwan, T.C. (Lawrence Livermore National Lab., CA (USA)). 1987. NTIS, PC A07/MF A01. Order Number DE88002817/JAW. Contract W-7405-ENG-48.

From Conference on cellular molecular aspects, radiation induced DNA damage and repair; Albuquerque, NM, USA (10 Mar 1987).

Mutations induced by radiation in resting oocytes have curiously not been found in mice, despite impressive searches. Super-repair has been suggested. However, in mice resting oocytes are extremely easily killed by radiation; in women they are not. This raises questions of interspecies data relevance that need clarification. The authors found, in experiments using gamma rays, low-energy neutrons, accelerated heavy ions, and beta rays, that the hypersensitive lethality target in mouse immature oocytes is apparently the plasma membrane, not the DNA. Microdosimetric and Monte Carlo analyses then confirmed that masking of mutations by cell killing is a sufficient explanation of earlier negative genetic findings. Super-repair, however, was not excluded. Now, using monoenergetic 0.43-MeV neutrons and ^{252}Cf radiation and taking the hypervulnerable lethality target into account, they demonstrate, for the first time, that radiation can indeed leave unrepaired cytogenetic damage in mouse resting oocytes.

41543 (CONF-8703182—Summs., pp 92) **CHO mutant defective in repair of x-ray induced DNA base damage.** Fuller, L.F.; Painter, R.B. (Univ. of California, San Francisco (USA)). 1987. NTIS, PC A07/MF A01. Order Number DE88002817/JAW. Contract AC03-76SF01012.

From Conference on cellular molecular aspects, radiation induced DNA damage and repair; Albuquerque, NM, USA (10 Mar 1987).

An x-ray sensitive Chinese hamster ovary cell line (Clone 22) was isolated using a semi-automated procedure in which mutagenized CHO cells were allowed to form colonies on top of agar, x-irradiated, then photographed at two later times. Comparison of the photographs allowed the identification of colonies that displayed significant growth arrest. One of the colonies identified in this manner produced a stale, radiosensitive line. This cell line is normal in x-ray-induced double-strand break repair, but repairs single-strand breaks somewhat slower than the parental line does. It performs about half as much x-ray-induced repair replication as the parental line, indicating a defect in excision repair of x-ray-induced base damage. This deficiency in excision repair is believed to be the primary cause of the line's radiosensitivity. This line produces significantly higher numbers of x-ray-induced chromosomal aberrations than the parental line and it exhibits high frequencies of chromatid aberrations after irradiation in the G_1 phase of the cell cycle. The frequency of spontaneous SCE is normal. The line is hypomutable to x-ray-induced 6-thioguanine resistance.

41544 (DOE/EH—0069) **Radiation exposures for DOE and DOE contractor employees: Nineteenth annual report, 1986.** (Pacific Northwest Lab., Richland, WA (USA)). Dec 1987. Contract AC06-76RL01830. 57p. NTIS, PC A04/MF A01;1; GPO Dep. Order Number DE88009860/JAW.

All US Department of Energy (DOE) and DOE contractors are required to submit occupational radiation exposure records to a central repository. The data required include a summary of whole-body exposures to ionizing radiation and a summary of internal depositions of radioactive materials above specified limits. This report is a summary of the data submitted by DOE and DOE contractors for 1986. A total of 94,040 DOE and DOE contractor employees were monitored for whole-body ionizing radiation exposures in 1986. This represents 56.2% of all DOE and DOE contractor employees. In addition to the employees, 63,463 visitors were monitored. The collective dose equivalent for DOE and DOE contractor employeees was 7,911 person-rem. The collective dose equivalent for visitors was 554 person-rem. The highest average dose equivalent for all monitored individuals was observed at fuel fabrication facilities (205 mrem), and the lowest was observed for visitors (9 mrem) to DOE facilities. These averages are significantly less than the DOE 5-rem/year radiation protection standard for whole-body exposures. Three new cases of internal depositions were reported in 1986 that exceeded 50 percent of the pertinent annual dose-equivalent standard. Of these three cases, two occurred in 1974 and are reported now because recent revisions in the dose calculations established these cases as reportable depositions. The third case occurred in 1985, but was not reported until evaluation was completed in early 1987. There were no uptakes of radioactive material reported to have occurred in 1986.

41545 **(DOE/ER/60396—4) [Molecular basis of the mutagenic and lethal effects of ultraviolet irradiation]: Progress report.** (Johns Hopkins Univ., Baltimore, MD (USA). School of Hygiene and Public Health). [1988]. Contract FG02-86ER60396. 6p. NTIS, PC A02/MF A01;1; GPO Dep. Order Number DE88011257/JAW.

Studies on the molecular mechanisms by which Escherichia Coli and Micrococcus luteus repair pyrimidine dimers induced in their DNA by ultraviolet light are reported. The studies involve the isolation and enzymatic activity of the ucr system. The specific roles of ucr A and ucr B proteins are sought. In addition the expression of the ucr genes in mammalian cells is addressed. 35 refs. (DT)

41546 **(GSF—18/87) Investigation of centers sensitive to S1-nuclease in the genoma of the yeast S. cerevisiae after in-vivo exposure to gamma radiation.** Geigl, E.M. (Gesellschaft fuer Strahlen- und Umweltforschung m.b.H. Muenchen, Neuherberg (Germany, F.R.). Abt. fuer Strahlenbiologie). Sep 1987. 183p. (In German). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88754150/JAW.

The structure, distribution and repair of basal damage in DNS after exposure to /sup 60/Co gamma radiation were investigated in S. cerevisiae cells. Small DNS regions with mispaired or unpaired bases of rather high stability were found whose rate of incidence and linear dose dependence appear to be similar to those of double strand breaks. In contrast to double strand breaks, they showed no statistical' distribution pattern across the genoma. Liquid holding experiments showed that centers sensitive to S1-nuclease will be repaired in S. cerevisiae by a combined process of recombination and postreplication repair; the gene products of the genes RAD50 and RAD18 are involved.

41547 **(GSF-BPT—6/86) Effects of enhanced UV-B radiation in combination with other stress factors on the growth and function of agricultural plants. Final report.** Tevini, M.; Steinmueller, D.; Iwanzik, W. (Karlsruhe Univ. (T.H.) (Germany, F.R.). Botanisches Inst. 2). (Gesellschaft fuer Strahlen- und Umweltforschung m.b.H. Muenchen, Neuherberg (Germany, F.R.). Bereich Projekttraegerschaften). 1986. 179p. (In German). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88754010/JAW.

Measurements of variable fluorescence, oxygen production and absorption changes suggested that the reaction centers of photosystem II are inhibited by UV-B radiation and, at the same time, are changed into dissipative sinks for the excitation energy. Selective impairment of water splitting is excluded as a cause of the inhibition of the primary processes of photosynthesis. The activity of photosystem I is not affected.

41548 **(GSI—87-20) Heavy ion induced DNA strand breaks and their repair in diploid cells of the epithelium of the lens.** Heilman, J. (Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (Germany, F.R.); Bonn Univ. (Germany, F.R.)). Nov 1987. 101p. (In German). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88753794/JAW.

This diploma thesis investigates by means of alkaline unwinding and neutral elution the induction of DNA strand breaks and of rejoining processes as an effect of irradiation with very heavy, accelerated ions. It is found that: The effectiveness of very heavy ions ($Z > 18$) increases per particle with higher ordinal number, and with increasing velocities. The relative biological effectiveness increases with higher particle masses and lower velocities. The effects of very heavy ions are determined both by the LET and by the particle track extension (specific energy) of the various particles. Heavy ions are much more effective than X-rays with regard to inducing double strand breaks, as compared to DNA single strand breaks induced. Rejoining processes induced by heavy ions have been found to be delayed and incomplete, as compared to the X-ray effects. The number of rejoining processes decreases with rising ordinal number. The experiments indicate that the irradiation with lead or uranium ions most probably makes rejoining impossible. (orig./MG)

41549 **(GSI—88-03(Prepr.)) Effects of LET, fluence and particle energy on inactivation, chromosomal aberrations and DNA strand breaks.** Kraft, G. (Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (Germany, F.R.)). Jan 1988. 23p. (CONF-8710285—). Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (Germany, F.R.).

From NATO advanced study institute on terrestrial space radiation and its biological effects; Corfu, Greece (12 Oct 1987).

Experiments are described studying the inactivation and the induction of chromosomal aberrations in mammalian cells. In addition, experiments of the induction of single and double strand breaks of DNA in mammalian cells will be compared to the induction of single and double strand breaks of DNA in solution. (orig./MG)

41550 **(IC—88/32) Effects of He-Ne laser beam on mechanical, heat, chemical and superficial wounds.** Kakai, S.F.K.; Albarwari, S.E.; Alsenawi, T.A. (International Centre for Theoretical Physics, Trieste (Italy); College of Medicine, Erbil (Iraq). Dept. of Anatomy; College of Science, Erbil (Iraq). Dept. of Physics). (International Centre for Theoretical Physics, Trieste (Italy)). Feb 1988. 9p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88703164/JAW.

This study summarizes the effects of low-doses of He-Ne laser radiation ($\lambda = 6328$ A), on healing of four types of wounds, including mechanical, heat, chemical and superficial wounds. The results revealed that variations between complete wound-closure in irradiated samples and that of control groups were statistically significant. Moreover, the results suggest that the stimulative action of laser is an accumulative phenomenon, that affects factors involved in the course of wound healing. The results also indicate that the skin epithelium is a highly responsive tissue towards this sort of radiation, which suggests that the stimulative action of He-Ne laser could be assayed easily by using such tissues as a test target. (author). 11 refs, 2 tabs.

41551 **(IC—88/33) Enhancing the healing processes of chemical burns with He-Ne radiation.** Kakai, S.F.K.; Albarwari, S.E.; Alsenawi, T.A. (International Centre for Theoretical Physics, Trieste (Italy); College of Medicine, Erbil (Iraq). Dept. of Anatomy; College of Education, Erbil (Iraq). Dept. of Physics). (International Centre for Theoretical Physics, Trieste (Italy)). Feb 1988. 11p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703165/JAW.

The process by which He-Ne laser radiation ($\lambda = 632.8$ nm) enhances the healing of cutaneous wounds, made by concentrated nitric acid on mice has been studied. The dose used was of the order of 2.7 Joule per day, till the day of complete wound closure. The wounds were irradiated at three points on its periphery so that to form a semitriangular pattern this method was adopted, because chemical burns involve the killing of both the epidermis and dermis. The influence of the laser on the healing was estimated quantitatively and statistically, with a significance of $p<0.001$ over the control (the unirradiated). (author). 8 refs, 2 figs, 2 tabs.

41552 **(INIS-mf—11684) System for the automatic detection of dicentric chromosomes.** Loerch, T. (Heidelberg Univ. (Germany, F.R.). Naturwissenschaftlich-Mathematische Gesamtfakultaet). 1986. 135p. (In German). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88753796/JAW.

The biological dosimetry presents an independent supplement to physical dosimetry and is therefore of importance in the area of radiation safety. Its increased use, however, is hindered at this time because of the large amount of work required. One way out of this situation can be offered by the automatization of the analysis by means of digital image processing. For this purpose a system hardware was developed which is based on a traditional light microscope with a computer-controlled movable base plate. For image transformation a television camera was used, whose signal was evaluated by a special measurement electronic in real time. A differentiated image analysis was made possible by a binary image and a grey scale image storage, the therefore necessary high

computing ability was offered by the POLYP multimicroprocessor system. The automatic evaluation can be divided into three steps: metaphase search, segmentation and aberration analysis; an interactive examination of the discovered aberrations was joined to this. A computing time estimate taking into consideration the attained error rates indicates that it can be expected that an analysis can be concluded within 11 hours. Of these only 2 hours are man-hours, whereas the conventional method requires 5 to 10 working days. The practical use of the system for the automatic detection of dicentric chromosomes is thereby made more realizable. (orig./MG)

41553 **(INIS-mf—11699) Acute radiation syndrome in the miniature pig Troll.** Siegl, R. (Muenchen Univ. (Germany, F.R.). Fachbereich Tiermedizin). 25 Jul 1986. 82p. (In German). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88753806/JAW.

8 animals at an average age of 230 days and an average body weight of 24.9 kg were whole-body gamma-irradiated from a cobalt-60 source with 3.0 Gy midline dose. 4 of the 8 pigs survived, the others died within day 14 and 17 after irradiation, mainly due to thrombopenia dependent hemorrhage. Hematologic examinations showed as well that the platelets decreased to a minimum on day 14 p.r. The granulocyte values and yet remarkable the lymphocyte values decreased at an earlier time. The absolute lymphocyte counts reached their lowest mark already on the first day after irradiation. The reticulocytes, which also decreased markedly on day 1 p.r., sank further on the following days, till after two weeks when they started to increase again. Furthermore 25 biochemical serum parameters have been investigated. The major pathological findings of the acute radiation sickness were the mostly heavy hemorrhages. Histological studies indicated primarily aplasia of bone marrow, intestinal mucosa damages and atrophy of lymphatic tissues. Signs for septicemia were rarely found. The investigations in Troll-pigs showed, their reactions to an irradiation of middle-lethal doses are similar to those of other pigs. Only the Vietnamese pot-bellied swine reacts differently: Profuse diarrheas already after low radiation-doses are reported. (orig./MG)

41554 **(INIS-mf—11707) Observations of motor reactions to ions, hormones, pharmaceuticals, electrical stimulation and X irradiation in intraoperatively removed human genital preparations (myometrium, tuba uterina and genital vessels).** Werner, A. (Muenchen Univ. (Germany, F.R.). Fakultaet fuer Medizin). 5 Mar 1987. 109p. (In German). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88753808/JAW.

Elementary physiological, pharmacological and radiological characteristics of isolated genital preparations - myometrium, tuba uterina and genital vessels - from human op material were compared and analysed. The basal tone and the spontaneous contractile activity were dependent on the sodium, potassium and calcium chloride concentration in the nutritive solution. Observations of the motor reactions of the preparations of myometrium and tuba uterina to hormones and their antagonists confirm or indicate the presence of specific hormone receptors. X-radiation caused a tonic contraction and changes in the spontaneous contractile activity in myometrium preparations. Uterine and ovarian vessels reacted to irradiated with definite and often enduring tonic contractions. Theophyllin, a substance with an inhibiting affect on phosphodiesterase, which leads to an increase in intracellular cAMP concentration, works against the X-radiation influence. (MBC)

41555 **(INIS-mf—11714) Double strand breaks in DNA in vivo and in vitro after ^{60}Co-γ-irradiation.** Huelsewede, J.W. (Bochum Univ. (Germany, F.R.). Abt. fuer Chemie). 6 Feb 1985. 159p. (In German). NTIS (US Sales Only), PC A08/MF A01. Order Number DE88753814/JAW.

The questions of what the correlation is between double strand breaks in DNA in the cell and lethal radiation damage and by means of which possible mechanisms DNA double strand breaks could occur were studied. E. coli served as test system. In addition to this the molecular weight of the DNA from irradiated E. coli as a function of the radiation dose under various conditions was measured. This data was compared on the one hand to the survival of the cell and on the other hand to the formation of DNA double strand breaks in an aqueous buffer system, which in its ionic characteristics was similar to cell fluids. (orig./MG)

41556 **(INIS-mf—11746) Investigations of the dependence of radiation effects on the stem cells of the small intestine mucous membrane on dose fractionation.** Gindele, S. (Muenchen Univ. (Germany, F.R.). Fakultaet fuer Medizin). 20 Nov 1984. 39p. (In German). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88754019/JAW.

For the study of the dependence of the radiation effects on the stem cells of the small intestine mucous membrane on dose fractionation mice from the strain C3H were exposed to a one-time irradiation, an irradiation in three fractions, five fractions on one day, five fractions on two days and an irradiation in ten fractions. It was shown, that the survival curves for the higher fractionation numbers were shifted to the right from the ones with higher total doses and have a lower slope than the curves lying more to the left. The accumulation of a total dose for an iso-effect is not proportional to the increase in the number of fractions, but instead in the area above 5 fractions reaches a plateau. The survival curve of the one-time dose which I constructed in the shoulder area showed a strong agreement with the survival curve which was given by Withers and Hussey.

41557 **(INIS-mf—11748) Radiation-induced chromosomal aberrations in the lymphocytes of various species of mammals and the influence of coffeine during the G-2 phase.** Rosenthal, M. (Freie Univ. Berlin (Germany, F.R.). Fachbereich Biologie). 4 Jul 1983. 247p. (In German). NTIS (US Sales Only), PC A11/MF A01. Order Number DE88754021/JAW.

The cellular kinetics and the G0-radiation sensitivity of human, chimpanzee, swine and rabbit lymphocytes were investigated using the lymphocytes test system (Ham's F-10 Medium, PHA). Due to the integration of BrdU in the DNA (S-phase), the author was able to distinguish between first, second and third mitoses (M1, M2, M3) in accordance with the differential colouring of the metaphase chromosomes which took place according to the labelling pattern. When checking the G0-radiation sensitivity of the lymphocytes, the rates of chromosomal aberrations in the metaphases of the first and second mitoses were evaluated separately. The different radiation sensitivities are thought to be due to interspecies differences in the repair capacity of the lymphocytes. In the metaphases of second mitoses, the rate of dicentric chromosomes is approximately half of that in M1-metaphases. Ring chromosomes were nearly as frequent in M2-metaphases as in M1-metaphases. In the second experimental phase, the effects of coffein on the aberration rates after radiation exposure of the lymphocytes in the G2 phase was investigated. Achromatic lesions, open chromatide breaks, and translocations were evaluated. Aberration rates were found to increase with the radiation dose and to decrease with the cultivation time after radiation exposure. There was no marked effect of coffein on the aberration rates. The progress of the G2 phase was measured in terms of the rate of radioactively labelled metaphases, which increased with the cultivation time. This labelling index was lower in the exposed cultures than in the control cultures, suggesting a radiation-induced delay of the G2 phase. The labelling indexes of all cultures were enhanced after coffein treatment, suggesting a coffein-induced acceleration of the G2 phase.

41558 **(JINR-E—19-87-465) Biological effects of very low doses of ionizing radiation.** Evseev, V.S. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1987. 6p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88703372/JAW.

The paper deals with a qualitative microdosimetric analysis of a new radiobiological phenomenon (physiological reaction of the cell as a whole to very low doses of ionizing radiations). The analysis is aimed at identifying the type of the primary interaction of radiation with the cell and finding its place in the cell. 8 refs.; 1 fig.

41559 **(KFK—4380) Histomorphological and histomorphometrical investigations of early bone damage following incorporation of optimal carcinogenic doses of 239-plutonium in male rats of different age.** Gamer, A.O. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Genetik und Toxikologie von Spaltstoffen; Giessen Univ. (Germany, F.R.). Fachbereich Veterinaermedizin und Tierzucht). Feb 1988. 165p. (In German). NTIS (US Sales Only), PC A08/MF A01. Order Number DE88753834/JAW.

There is early damage to bone at small carcinogenic amounts of the nuclide, including heavy defects of bone structure and bone marrow osteoporotic features of trabecular bone and only histomorphometrically detectable changes in bone metabolism. The dependence of radiation dose to skeleton and the spacial distribution of the nuclide on age and growth of the experimental animals is demonstrated and correlated to the histological findings. It is also shown that growth and metabolism parameters of bone influence the decorporation performance of the chelating agent Zn-DTPA. (orig.)

41560 **(LBL—22347) A user's guide to computer programs for the analysis of cellular survival data.** Albright, N. (Lawrence Berkeley Lab., CA (USA)). Jan 1988. Contract AC03-76SF00098. 126p. NTIS, PC A07/MF A01. Order Number DE88008419/JAW.

Four computer programs have been developed for the analysis of cellular dose-survival data. The programs enable the user to build a computer database of cellular dose-survival data, calculate cell survival with a correction for cell multiplicity at the time of irradiation, fit various survival models to the data by iteratively weighted least squares, calculate standard errors and confidence intervals of fitted survival curve parameters, calculate ratios of the doses for which two or more survival curves have a specified survival level, e.g., oxygen enhancement ratio (OER) and relative biological effectiveness (RBE), calculate ratios of the survival levels of two or more survival curves for a specified dose, calculate the standard errors of these ratios, make plots of data and survival curves on the user's computer terminal, send these plots to a plotter, and save plot information for subsequent plotting by another program. The programs are written in Fortran, run on a VAX computer, and can be used with a variety of graphics devices. 38 refs.

41561 **(NIRS-R—13) Research report for radioactivity survey (1986).** (National Inst. of Radiological Sciences, Chiba (Japan)). Nov 1987. 137p. (In Japanese). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88753647/JAW.

This report gives the results of the 1986's research projects. The following research projects are covered: (I) research for radioactivity level and dosimetry in environment, food, and human body; (II) research for radioactivity level surrounding nuclear installations; (III) work in a radioactivity survey data center; (IV) basic research on the evaluation of radioactivity survey; (V) training of technicians for monitoring environmental radioactivity; and (VI) research on emergency countermeasures, including dosimetry. The results are provided mainly in tabular form. Some references are given in (VII). (Namekawa, K.).

41562 **(PNL—SA-14719) The changing emphases in health physics.** Denham, D.H.; Kathren, R.L. (Pacific Northwest Lab., Richland, WA (USA); Hanford Environmental Health Foundation, Richland, WA (USA)). Nov 1987. Contract AC06-76RL01830. 5p. (CONF-880404—12). NTIS, PC A02/MF A01; GPO Dep. Order Number DE88008197/JAW.

From 7. international congress of the International Radiation Protection Association; Sydney, Australia (10 Apr 1988).

This paper explores the changing emphases in health physics as evidenced by the subject matter of published papers in four primary English language journals of interest to health physicists. Articles from each journal were first grouped by subject and date of publication and were then compiled according to the list of professional domains practiced by health physicists. Five domains of practice were examined, measurements including dosimetry and environmental monitoring; regulations and standards; facilities and equipment including shielding, ventilation, and instrumentation; operations and procedures; and education and training. 2 tabs.

41563 **(PNL-SA—14845) Human respiratory tract model for radiological protection: A revision of the ICRP dosimetric model for the respiratory system.** Bair, W.J. (Pacific Northwest Lab., Richland, WA (USA)). Dec 1987. Contract AC06-76RL01830. 5p. (CONF-880404—10). NTIS, PC A02/MF A01. Order Number DE88008195/JAW.

From 7. international congress of the International Radiation Protection Association; Sydney, Australia (10 Apr 1988).

A quantitative kinetic clearance model for inhaled radioactive aerosols is discussed. Clearance of particles is competitive and assumed to be nonlinear. Mathematical models for calculating radiation doses to various respiratory tract tissues will be developed. The proposed model is expected to simplify calculating respiratory tract doses from bioassay data. (CBS)

41564 **(RERF-TR—12-87) Life span study report 11, part 1. Comparison of risk coefficients for site-specific cancer mortality based on the DS86 and T65DR shielded kerma and organ doses.** Shimizu, Yukiko; Kato, Hiroo; Schull, W.J.; Preston, D.L.; Fujita, Shoichiro; Pierce, D.A. (Radiation Effects Research Foundation, Hiroshima (Japan)). Nov 1987. 62p. (In Japanese, English). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88753648/JAW.

In 75,991 A-bomb survivors, shielded kerma and organ doses were calculated based on the new dosimetry system 1986 (DS86) and the previous tentative 1965 dose revised (T65DR) to compare risk coefficients for site-specific cancer mortality during the period 1950 - 1985. As for shielded kerma, the excess relative risk over the various sites and the excess numbers of cancer deaths per 10/sup 4/ person-year-gray were 1.35 - 1.51 and 1.38 - 1.61 times higher, respectively, under the DS86 than under the T65DR. The attributable risks did not differ in the two dosimetric systems. The risk coefficients based on the DS86 organ-absorbed doses were generally smaller than those based on the T65DR values. The difference in cancer mortality between Hiroshima and Nagasaki was smaller with the DS86 than with the T65DR; however, this was not statistically significant for either shielded kerma and organ-absorbed dose. (Namekawa, K.).

41565 **(RERF-TR—13-85) Electrophoretic variants of blood proteins in Japanese, 7. Cytoplasmic glutamate-oxaloacetate transaminase (GOT1).** Satoh, Chiyoko; Takahashi, Norio; Kimura, Yasukazu; Miura, Akiko; Kaneko, Junko; Fujita, Mikio; Toyama, Kyoko. (Radiation Effects Research Foundation, Hiroshima (Japan)). Nov 1986. 16p. (In Japanese and English). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88754138/JAW.

A total of 16,835 children, of whom 11,737 are unrelated, from Hiroshima and Nagasaki were examined for erythrocyte cytoplasmic glutamate-oxaloacetate transaminase (GOT1) by starch gel electrophoresis. A variant allele named GOT1*2HR1 which seems to be identical with GOT1*2 was encountered in polymorphic frequency. Five kinds of rare variants, 3NG1, 4NG1, 5NG1, 6HR1, and 7NG1 were encountered in a total of 109 children. Except for 7NG1 for which complete family study was unable, family studies confirmed the genetic nature of these rare variants, since for all instances in which both parents could be examined, one of the parents exhibited the same variant as that of their child. Thermostability profiles of these six variants were normal. The enzyme activities of five were decreased, while the value of one was normal compared to that of GOT1 1.

41566 **(SAAS—358) Enzyme diagnostics following radiation exposure. Usefulness and limits.** Seher, C. (Staatliches Amt fuer Atomsicherheit und Strahlenschutz, Berlin (German Democratic Republic)). 1988. 37p. (In German). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703082/JAW.

Based on the results of animal studies and a literature survey, recommendations are given for the application of enzyme diagnostics in the following fields of radiation protection medicine: (1) preemployment medical examinations and health supervision of radi-

ation workers, (2) medical examinations following chronic radiation exposure, and (3) medical examinations following acute radiation exposure.

41567 (TsNIIATOMINFORM-ON—5) Body burden of fallout /sup 137/Cs in the inhabitants of Moscow in 1980-1983. Moiseev, A.A.; Stolyarov, V.P.; Drabkina, I.B.; Polunin, V.P. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow; Ministerstvo Zdravookhraneniya SSSR, Moscow. Natsional'naya Komissiya po Radiatsionnoj Zashchite). 1986. 12p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702833/JAW.

Several groups of people living in Moscow were measured for fallout /sup 137/Cs in 1980-1983. In vivo measurements of incorporated /sup 137/Cs were made with use of a whole-body counter. The minimum measurable activities of /sup 137/Cs were 37 and 17 Bq consequently for time of measurement 15 and 30 min. All persons measured were classified into four groups, personnel of whole-body counters laboratory, teenagers-sportsman, patients of a Moscow hospital (with heart and kidneys diseases) and normal adults-inhabitants of Moscow. The activity of /sup 137/Cs in the normal adults and patients was observed to decrease during the period of investigation. It was shown that by the end of 1983 the great majority of the results were similar and below the minimum measurable activity (for time of measurement 15 min). 3 figs.; 4 tabs.

41568 (UCRL—50027-87) Environmental monitoring at the Lawrence Livermore National Laboratory: Annual report, 1987. Holland, R.C.; Brekke, D.D. (Lawrence Livermore National Lab., CA (USA)). Apr 1988. Contract W-7405-ENG-48. 166p. NTIS, PC A08;3. Order Number DE88010367/JAW.

This report documents the results of the Environmental Monitoring Program at the Lawrence Livermore Laboratory (LLNL) for 1987. To evaluate the effect of LLNL operations on the local environment, measurements were made of direct radiation and a variety of radionuclides and chemical pollutants in ambient air, soil, sewage effluents, surface water, groundwater, vegetation, foodstuff, and milk at both the Livermore site and nearby Site 300. Evaluations were made of LLNL's compliance with the applicable guides, standards, and limits for radiological and nonradiological releases to the environment. The data indicates that the only releases in excess of applicable standards were four releases to the sanitary sewer. LLNL operations had no adverse impact on the environment during 1987. 65 refs., 24 figs.

41569 Postmenopausal loss of Ra acquired in adolescence or young adulthood: quantitative relationship to radiation-induced skeletal damage and dosimetric implications. Keane, A.T.; Rundo, J.; Essling, M.A. (Argonne National Lab., IL (USA)). *Health Physics;* **54**: No. 5, 517-527(May 1988).

From the results of serial measurements of body ^{226}Ra activity in 13 former luminous dial workers 30-60 y after relatively brief periods of intake of luminous compounds in adolescence or young adulthood, we determined the postmenopausal rate of elimination of Ra in percent of contemporary body Ra content per year. This rate was negatively correlated with the reduced x-ray score, a measure of radiation osteonecrosis observed radiographically in the 13 subjects ($r = -0.85$, P less than 0.001). The clearance rates of subjects retaining low Ra activity were greater than predicted by retention models. We conclude that for those members of the Ra-exposed population under study for health effects at our institution who sustained the lesser degrees of macroscopic skeletal damage, present estimates of skeletal absorbed dose are systematically low, by at most a factor of 2.

41570 Chemical exposures and central nervous system cancers: a case-control study among workers at two nuclear facilities. Carpenter, A.V.; Flanders, W.D.; Frome, E.L.; Tankersley, W.G.; Fry, S.A. (Oak Ridge Associated Universities, TN (USA)). *American Journal of Industrial Medicine;* **13**: No. 3, 351-362(1988).

In a nested case-control study of workers employed between 1943 and 1977 at two nuclear facilities, we evaluated the possible association of primary CNS cancers with occupational exposure to chemicals. Seventy-two white male and 17 white female workers who, according to the information on death certificates, died of primary CNS cancers were identified as cases. For each case, four controls were matched on race, sex, facility at which initially employed (cohort), year of birth, and year of hire. Each job title/department combination was subjectively evaluated for potential exposure to each of 26 chemicals or chemical groups. Statistically significant associations were not found between CNS cancer deaths and any of the 26 chemicals. An increased risk of CNS cancer occurrence was observed among subjects employed for more than 20 yr (OR = 7.0, 95% CI = 1.2,41.1, cases = 9).

41571 Techniques and applications of image correlation in radiotherapy treatment planning. Kessler, M.L.; Pitluck, S.; Chen, G.T.Y. (Lawrence Berkeley Lab., Berkeley, CA (US)). pp 25-32 of Treatment planning in the radiation therapy of cancer. Vaeth, J.M.; Meyer, J. New York, NY; S. Karger Publishers Inc. (1987). (CONF-8602158—).

From 21. annual San Francisco cancer symposium; San Francisco, CA, USA (28 Feb 1986).

The authors have shown an image correlation technique well suited for the analysis of intracranial lesions above the base of the skull, where surgical burr holes serve as landmarks to define the transformation between initial and subsequent CT scans. The technique is a valuable tool to relate dose distributions from the initial therapy with clinical findings imaged on subsequent CT studies. Beyond this clinical example, the authors envision a number of important applications of image correlation techniques in radiology and radiation therapy. Multiple imaging studies are a reality in the complex management of patients. Techniques in image correlation which provide accurate spatial relationships among these studies will be of great value to both diagnostic radiologists and radiation therapists.

41572 Radiopharmaceutical absorbed dose considerations. Coffey, J.L.; Watson, E.E.; Hubner, K.F.; Stabin, M.G. (Syncor International Corp., Albuquerque, NM (US)). pp 51-74 of Essentials of nuclear medicine science. Hladik, W.B. III; Saha, G.B.; Study, K.T. Baltimore, MD; Williams and Wilkens (1987).

From the discussion in this chapter the reader may get the impression that absorbed dose calculations are primarily guesswork. Admittedly, assumptions must be made in some calculations when there are gaps in the available data. These calculations, however, represent an estimate of the true absorbed dose with reasonably sufficient accuracy to assure the physician and regulatory agencies that patients are not receiving excessively high absorbed radiation doses. The MIRD technique appears to be an acceptable method of dose calculations, with individual calculations being only as good as the input information. All possible situations have not been modeled, nor will they ever be, but absorbed dose estimation can continue to be of use with application of available data, some common sense, and a few reasonable assumptions.

41573 A somatic cell and molecular genetics approach to DNA repair and mutagenesis. Thompson, L.H. (Biomedical Sciences Div., Lawrence Livermore National Lab., P.O. Box 5507, Livermore, CA 94550 (USA)). pp 161-170 of Genetic toxicology of environmental chemicals. Ramel, C.; Lambert, B.; Magnusson, J. New York, NY; Alan R. Liss Inc. (1986). (CONF-8506373—).

From Genetic toxicology of environmental chemicals, part A: basic principles and mechanisms of action; Stockholm, Sweden (24 Jun 1985).

The authors' laboratory and others showed the feasibility of isolating mutant cell lines induced in culture that had markedly increased sensitivity to far ultraviolet (UV) radiation or certain chemical mutagens. In the CHO cell line, UV-sensitive mutants representing five genetic complementation groups have been identified. Mutants from each of these groups were shown to be defective in performing the incision step of repair after exposure to UV. In this respect, they closely resemble mutant human cells from individuals with the cancer-prone xeroderma pigmentosum (XP) syndrome. Whether any of the rodent cell mutants are altered in the same genes as XP cells remains to be determined.

41574 **Photoreactivation and other ultraviolet/visible light effects on DNA in human skin.** Sutherland, B.M.; Blackett, A.D.; Feng, N.I.; Freeman, S.E.; Ogut, E.S.; Gange, R.W.; Sutherland, J.C. (Biology Dept., Brookhaven National Lab., Upton, NY 11793 (USA)). pp 73-79 of The medical and biological effects of light. Wurtman, R.J.; Baum, M.J.; Potts, J.T. New York, NY; The New York Academy of Sciences (1985). (CONF-8410211—).

From New York Academy of Science conference on medical and biological effects of light; New York, NY, USA (31 Oct 1984).

Wavelengths of light present in sunlight, sunlamps, and fluorescent and incandescent lamps induce changes in human skin DNA in a multiplicity of reactions. UVB and UVA exposures can induce damage in DNA as well as can the inducement of tanning to protect against such damage. Longer wavelength ultraviolet radiation can mediate enzymatic (or perhaps nonenzymatic) reversal of dimers. None of the action spectra, kinetics, or other characteristics of such reactions are known. Elucidation of their properties will provide essential information to allow evaluation of the interaction of light with human skin DNA.

5603 Chemicals Metabolism And Toxicology

REFER ALSO TO CITATION(S) 39113, 39619, 41228, 41234, 41250, 41363, 41400, 41416, 41424, 41526, 41540

41575 **(AD-A—190851/6/XAB) Preliminary assessment of the relative toxicity of copper naphthenate acute studies. Phase 2. May 1984-June 1986. Study report.** Angerhofer, R.A.; Taylor, L.M. (Army Environmental Hygiene Agency, Aberdeen Proving Ground, MD (USA)). 5 Jan 1988. 73p. (USAEHA—75-51-0497-87). NTIS, PC A04/MF A01.

A series of studies was performed in laboratory animals and biological systems to determine the relative toxicities of copper naphthenate and a wood-preservative formulation thereof. The studies included primary skin and eye irritation, acute oral and dermal toxicity, skin sensitization, saturated vapor inhalation, mutagenicity screening, dominant lethal studies, avian toxicity and aquatic toxicity. The results of this testing indicated that Cunapsol 5 has the potential to cause severe irritation by the dermal and ocular routes. Copper naphthenate and Cunapsol 5 are of low toxicity by the oral route. Cunapsol 5 does cause death when applied to the skin of rabbits at moderate dosage levels. Recommendations provide for the wearing of protective eyewear, gloves, and coveralls by individuals involved in presentative treatment operations and that these operations should be carried out in well-ventilated areas. Due to the high degree of toxicity of copper naphthenate in one fish species, it was further recommended that disposal of excess preservative materials should be done in an environmentally acceptable manner.

41576 **(AD-A—191092/6/XAB) Lethal concentrations of heavy metals in tissue of earthworms. Interim report No. 2.** Bouche, M.B.; Brun, P.; Gal, J.Y.; Rida, A. (Montpellier-2 Univ., 34 (France)). Oct 1987. 18p. NTIS, PC A03/MF A01.

This toxicological research report addresses lethal concentrations of heavy metals in tissue of earthworms. We have presented the work in progress in the first interim report to improve 1) ecotoxicological test, 2) field procedures, and 3) standardization of analysis. This second interim report deals mostly with toxicity tests because the point (3) is now in order and the field work was impossible during the last dry season. Nevertheless, analysis of soil samples are in progress and most data are on computer files. The authors here develop more in detail point (1) new results or state of the art in the improvement of toxicity tests. 1) They have repeated the toxicity tests trying to get the LC50 for the different metals: cadmium, copper, arsenic and mercury. 2) They worked out a method to analyze earthworms. In the first part, results of the toxicity test are presented with their interpretations and, in the second part, the analytical method is examined and results are given of the test earthworms analyzed, trying to establish a relation between earthworms and artisol from which they come.

41577 **(AD-A—191093/4/XAB) Lethal concentrations of heavy metals in tissue of earthworms. Interim report No. 1, June-July 1987.** Bouche, M.B.; Brun, P.; Gal, J.Y.; Reza, A. (Montpellier-2 Univ., 34 (France)). Jul 1987. 5p. NTIS, PC A02/MF A01.

The objective of this phase of Toxicological Research on Lethal Concentrations of Heavy Metals in Tissue of Earthworms is to improve both ecotoxicological tests in a chemically defined medium and a procedure of bioavailability study in field. In this first period the authors worked on breeding stock of earthworms (species Eisenia fetida andrei) in decomposing manure heaps to increase them and make them grow. They also installed two chambers with thermostats fixed at 20 C to do toxicity tests and chose chemical species of heavy-metal contaminants. For field procedure, they improved a practical way to sample both earthworms and soil in very close connections, avoiding artifacts. For both field procedure and laboratory tests, they tried to standardize a method to dissolve earthworms in acids and to analyze the concentrations of heavy metals inside. A preliminary set of samples in calcareous soils was started and analysis of them are in progress. For lab tests, the first part of the test (preliminary test) was started with the different contaminants (cadmium, copper, arsenic, mercury) in an artificial medium named Artisol.

41578 **(AD-A—192138/6/XAB) Pyridostigmine interaction with soman during chronic exposure in rodents. Interim report, February-November 1987.** Kerenyi, S.Z.; Bruce, H.; Murphy, M.R.; Hartgraves, S.L. (School of Aerospace Medicine, Brooks AFB, TX (USA)). Jan 1988. 11p. (USAF-SAM-TR—87-38). NTIS, PC A03/MF A01.

The effects of repeated low-level nerve agent exposure on animal performance and lethality are a major concern of USAF Medical Research. This concern has generated interest in the role that pretreatment drugs such as pyridostigmine may play during simultaneous exposure to soman. This role was investigated by recording lethality, weights, symptoms, and cholinesterase (ChE) inhibition in rats chronically exposed to 4 levels of soman (32, 39, 48 or 59 micrograms/kg/day) while simultaneously receiving 10.0 milligrams/kg/day pyridostigmine, 1.0 milligrams/kg/day pyridostigmine, or vehicle via an osmotic pump. No effect (either protective or detractive) was found in the soman-poisoned animals due to the presence or absence of pyridostigmine. However, rat blood biochemistry is different from that of the primate, warranting further study in the primate before extrapolation to man.

41579 (CONF-8703182—Summs., pp 66-69) **Influence of normal epithelial cells on the development and expression of the neoplastic phenotype in carcinogen exposed rat tracheal epithelial cells.** Terzaghi-Howe, M. (Oak Ridge National Lab., TN (USA)). 1987. NTIS, PC A07/MF A01. Order Number DE88002817/JAW.

From Conference on cellular molecular aspects, radiation induced DNA damage and repair; Albuquerque, NM, USA (10 Mar 1987).

An inhibitory effect of normal epithelial cells on both preneoplastic and neoplastic tracheal epithelial cells using a cell culture as well as an in vivo model has been demonstrated. It is not clear at present whether inhibition observed in vivo in reconstructed tracheal mucosa occurs via the same mechanism as that occurring in intact carcinogen-exposed tracheal transplants, or whether the inhibition observed in cell culture shares any common mechanism with inhibition observed in cell co-cultures or in conditioned medium experiments. They are currently carrying out experiments designed to examine and elucidate these unresolved questions.

41580 (CONF-8703182—Summs., pp 80-81) **Control of mutagenesis and cell differentiation in cultured human cells.** Huberman, E. (Argonne National Lab., IL (USA)). 1987. NTIS, PC A07/MF A01. Order Number DE88002817/JAW. Contract W-31-109-ENG-38.

From Conference on cellular molecular aspects, radiation induced DNA damage and repair; Albuquerque, NM, USA (10 Mar 1987).

Using an in vitro mammalian cell-mediated mutagenicity assay with Chinese hamster V79 or human P3 cells as targets, they

showed that initiation may involve mutational events by demonstrating a relationship between the degree of mutagenesis by various chemical carcinogens in this assay and their tumor-producing potential in experimental animals. However, these types of studies usually entail genes that are not involved in the control of cell growth. To circumvent this problem, they chose to study carcinogen-induced alterations in a gene that codes for an enzyme involved in the regulation of cell growth: ionosine 5'-monophosphate dehydrogenase (IMPDH). An increase in the activity of this enzyme is also associated with development of malignancy and tumor growth progression. To obtain cells with altered IMPDH activity, they used mycophenolic acid (MPA), a specific, high cytotoxic inhibitor of IMPDH, for selection. Treatment of V79 cells with phorbol diesters resulted in cell variants resistant to MPA. By using a specific anti-IMPDH antiserum and a specific cDNA probe, which they isolated from a gt11 expression library, they showed in the MPA-resistant cells an increase in the amount and activity of IMPDH, which resulted from IMPDH gene amplification.

41581 **(CONF-8708254—1) Biological markers in animals can provide information on exposure and bioavailability of environmental contaminants.** Shugart, L.R.; Adams, S.M.; Jimenez, B.D.; Talmage, S.S.; McCarthy, J.F. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400;AC05-84OS21400. 15p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88010467/JAW.

From Symposium on chemical basis for biological monitoring; New Orleans, LA, USA (30 Aug 1987).

Epidemiologic studies of agents present in the environment seek to identify the extent to which they contribute to the causation of a specific toxic, clinical, or pathological endpoint. The multifactorial nature of disease etiology, long latency periods and the complexity of exposure, all contribute to the difficulty of establishing associations and casual relationships between a specific exposure and an adverse outcome. These barriers to studies of exposures and subsequent risk assessment cannot generally be changed. However, the appropriate use of biological markers in animal species living in a contaminated habitat can provide a measure of potential damage from that exposure and, in some instances, act as a surrogate for human environmental exposures. Quantitative predictivity of the effect of exposure to environmental pollutants is being approached by employing an appropriate array of biological end points. 34 refs., 1 fig., 6 tabs.

41582 **(CONF-8804140—2) Carbon allocation processes as indicators of pollutant impacts on forest trees.** McLaughlin, S.B. (Oak Ridge National Lab., TN (USA)). 1988. Contract AC05-84OR21400. 17p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88011009/JAW.

From National Research Council workshop on biological markers of air pollution exposure in trees; Little Switzerland, NC, USA (25 Apr 1988).

The physiological processes linking carbon assimilation and net primary production in forest trees offer a broad spectrum of reference points for documenting, evaluating, and predicting the effects of atomspheric pollutants on forests. Measurements of photosynthesis, dark respiration, leaf maintenance costs, energy storage reserves, secondary metabolites associated with plant resistance to pathogens, dry matter partitioning, and patterns of annual radial growth of forest trees represent useful indicators of pollutant effects that encompass levels of detection ranging from short term mechanistic processes to longer term responses that intergrate seasonal or multi-year effects. Productive utilization of measurements of these processes requires that particular emphasis be placed on (1) concurrent examination of multiple processes, (2) integration of information on these processes into a whole tree physiological context and (3) seasonal integration of temporal variations in the magnitude of measured responses. Collectively these processes can provide much needed tools for evaluating qualitative and quantitative changes in growth and physiological resilience of forest trees in relationship to chronic air pollutant exposure regimes.

41583 **(CONF-8805146—1) Problems and issues associated with evaluation of chemical mixtures in animal toxicity tests.** Reilly, C.A. Jr. (Argonne National Lab., IL (USA)). 1988. Contract W-31109-ENG-38. 4p. NTIS, PC A02/MF A01;1; GPO Dep. Order Number DE88011995/JAW.

From EPRI workshop on the biological evaluation of complex mixtures; Carmel, CA, USA (11 May 1988).

Human exposures to potentially toxic chemicals do not occur as isolated events involving individual compounds but rather as a combination of concurrent and sequential exposures to a myriad of chemicals. Each of these chemicals has its own toxicologic potential (often undetermined) with little or no information available as to its action in the context of combined exposures. Even in cases where the composition of a mixtures is well defined and invariant and its toxicity has been established, its effect in a combined exposure is probably unknown. As the mixture becomes more complex or less well-defined, the extrapolative power of the toxicity test becomes very limited. This presentation will focus on the difficulties of applying the results obtained in whole-animal toxicity assays to evaluation of risk of exposure to chemical mixtures with some thoughts on how one can perform the assays in a manner that maximizes their value for human health extrapolations.

41584 (DOE/BP—899, pp 195-206) **Effects of health treatments on smolt success.** Lorz, H.W. (Oregon State Univ., Corvallis (USA)). May 1987. NTIS, PC A12/MF A01. Order Number DE88003264/JAW. (CONF-8505378—).

From Workshop on smoltification and related research; Warm Springs, OR, USA (20 May 1985).

An attempt is made to review the problems or potential problems that may be encountered with the use of specific chemicals used in fish culture and management. Although the research continues and many chemicals are being used under Investigational New Animal Drugs permits, until the necessary information is obtained, only a few are approved for use on food fishes. The author lists some of the common chemicals and drugs being used to treat fish or algae and their registrational status.

41585 **(DOE/ER/60469—2) [Metabolism and toxicity of trace metals in the marine mussel, Mytilus edulis]: Status of project, July 1986-June 1987.** Roesijadi, G. (Maryland Univ., Solomons (USA). Center for Environmental and Estuarine Studies). 1987. Contract FG05-86ER60469. 9p. NTIS, PC A02/MF A01;1; GPO Dep. Order Number DE88008646/JAW.

A continuous-flow exposure system was constructed to tests molluscs for exposure to cadmium. Improved techniques for isolation and purification of molluscan metallothioneins (MT) were developed which allowed validation of the ELISA for mussel MT, the purification of oyster MT, development of antibodies against oyster MT, and continued progress on the developement of cDNA for mussel and oyster MT. The oyster, Crassostrea virginica, has been heavily utilized as a test species. In addition to development of isolation procedures and antibodies for the oyster MT, experiments have been initiated on the characterization of events associated with MT induction in the oyster. 3 refs., 2 figs., 3 tabs.

41586 **(DOE/EV/02040—T2) Factors affecting mutational specificity in mammalian cells: [Informal technical progress report], February 1, 1986-January 31, 1987.** Strauss, B.S. (Chicago Univ., IL (USA)). 1987. Contract AC02-76EV02040. 5p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88012387/JAW.

We analyzed the different c-H-ras mutations produced in cells after treatment with chemical carcinogens. The overall goal of this work is an understanding of the changes produced by environmental mutagens and carcinogens to learn how closely the results obtained with bacterial and cellular assay systems apply to the in vivo situation. Our work continues to utilize the technique for the study of DNA synthesis termination in vitro developed in this laboraory and utilized for the past several years. This technology can be characterized as a Sanger dideoxy sequencing technique with mutation induced lesions in the template strand serving as chain terminators instead of the dideoxynucleotides used in the Sanger technique to terminate the growing strand. We have added to this technique a modification for the study of termination on double stranded templates as possibly modeling more closely the natural situation. For this modification, double stranded M13 DNA is split once with a restriction enzyme which makes a unique cut and the linearized DNA is hybridized with single stranded circular DNA to

make a uniquely nicked double stranded circle with a single 3'OH to serve as a primer for DNA synthesis which can occur by either strand displacement or nick translation.

41587 (DOE/EV/02040—T3) Factors affecting mutational specificity in mammalian cells: Informal [technical] progress report, February 1, 1987-January 31, 1988. Strauss, B.S. (Chicago Univ., IL (USA)). 30 Sep 1986. Contract AC02-76EV02040. 4p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE88012304/JAW.

We analyzed the different c-H-ras mutations produced in cells after treatment with chemical carcinogens. The overall goal of this work is an understanding of the changes produced by environmental mutagens and carcinogens to learn how closely the results obtained with bacterial and cellular assay systems apply to the in vivo situation.

41588 (EPRI-EA—5817) Boron uptake and accumulation by higher plants: A literature review: Final report. Sposito, G.; Calderone, S.J. (Electric Power Research Inst., Palo Alto, CA (USA); California Univ., Riverside (USA). Dept. of Soil and Environmental Sciences). May 1988. 52p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88010641/JAW.

This study provides a review of the literature on boron uptake and accumulation by higher plants, particularly trees. It addresses those aspects of the soil chemistry of boron that are most relevant to uptake by trees, then discusses the plant biochemistry of boron, its uptake and accumulation in plant tissue, and its phytotoxicity symptoms in plant species. The literature reviewed suggests that boron uptake is accomplished by a passive, massflow mechanism, as opposed to a metabolic process, with the most likely chemical form taken up being the neutral complex, H_3BO_3. The biochemical role of boron is not well understood, but evidence exists for its involvement with carbohydrate transformations and the control of growth-regulating compounds. Because of the mass-flow uptake mechanism, the distribution of boron in trees is connected intimately with the patterns of transpiration, which are species-dependent. Precise data on the effect of plant genotype on boron uptake, however, were not found in the published literature. The phytotoxicity symptoms of boron in trees also are species-dependent, although a consensus does exist as to the general nature of external symptoms and the basis of boron tolerance.

41589 (IIUG-rep—86-5) Social relevance of environmental toxicology. Alsen, C.; Wassermann, O. (Wissenschaftszentrum Berlin fuer Sozialforschung gGmbH (WZB) (Germany, F.R.). Internationales Inst. fuer Umwelt und Gesellschaft). 1986. 109p. (In German). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88754004/JAW.

Environmental toxicology investigates harmful substances in the media air, water, soil and food. This field of research ascertains the effects on humans and on the living world not only to elucidate the causality of already apparent damage, but also to provide the rational basis for therapeutic attempts and, particularly, for prevention. The alarming scale of anthropogenic environmental pollution inevitably implies conflicts for committed environmental toxicologists with individuals or groups of the society interested to conceal and appease the facts. Considerable obstacles to successful toxicological research of environmental pollution come from the entanglement of interests between industry, politics and bureaucracy. Public pressure from well-informed and worried citizens initiatives, however, also convinced other scientific disciplines that in many instances environmental pollution has passed already justifiable limits. Each member of the society, especially those in industry and politics, must become aware of the fact, that conventional economy, which disregards ecological interrelations, cannot be financed in the future. (orig./HSCH).

41590 (LA-UR—88-1584) Cd-tolerance in plant cells: A comparison of biochemical and molecular properties of tolerant and sensitive cells. Jackson, P.J.; Robinson, N.J.; Delhaize, E. (Los Alamos National Lab., NM (USA)). 1988. Contract W-7405-ENG-36. 10p. (CONF-8804139—1). NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88010936/JAW.

From UCLA symposia; Frisco, CO, USA (10 Apr 1988).

Plant and plant cells can be selected for the ability to grow in the presence of normally toxic concentrations of certain trace metal ions. Metal-tolerance is often associated with the ability to produce large amounts of certain metal-binding polypeptides, poly(γ-glutamylcy-steinyl)glycines. The ability to produce these polypeptides plays an important role in Cd-tolerance since inhibition of their synthesis results in rapid cell death in the presence of metal ions. However, Cd-sensitive cells are also capable of synthesizing equivalent amounts of these compounds. Therefore, some other biochemical or physiological mechanism must also contribute to tolerance. Molecular and biochemical properties of Cd-tolerant {und Datura} {und innoxia} cells grown in the presence and absence of Cd were compared to those of Cd-sensitive cells grown under the same conditions. Certain biochemical and molecular differences which may contribute to tolerance were apparent.

41591 (LMF—120) Inhalation Toxicology Research Institute: Annual report, October 1, 1986 through September 30, 1987. Sun, J.D.; Mewhinney, J.A. (eds.). (Lovelace Biomedical and Environmental Research Inst., Albuquerque, NM (USA). Inhalation Toxicology Research Inst.). Dec 1987. Contract AC04-76EV01013. 708p. NTIS, PC A99;3. Order Number DE88008592/JAW.

This report provides a comprehensive summary of the research conducted at the Institute this past year, as well as ongoing studies. The first section contains papers related to aerosol generation and characterization. It addresses current research related to the physical properties of a number of airborne materials used in our research programs, which include studies on inhaled radon and cigarette smoke. The second section includes papers describing the deposition and fate of inhaled materials. It focuses on discussions concerning the fate of important chemical and radioactive materials in the body after they are inhaled. The third section, dose-response relationships for inhaled radionuclides, deals with the health effects from inhaled alpha- or beta-emitting radionuclide aerosols. Most of these papers are updates of ongoing life-span studies in dogs and rodents. The fourth section, dose-response relationships for inhaled chemical toxicants, deals with the health effects produced by inhaled chemicals. Papers in this section address not only the toxic effects of these inhaled materials, but also studies designed to elucidate the biological mechanisms involved in toxic responses. The final section, biological factors that influence dose-response relationships, contains papers dealing with a spectrum of significant biological relationships that need to be evaluated in order to understand the complex relationships that exist between exposure, dose, and the produced toxic effects. For those who would like to obtain a quick overview of the Institute's research, a brief synopsis, highlighting some of this year's important findings, is at the beginning of each section.

41592 (PB—88-195185/XAB) Use of simulation modeling in exposure and risk assessment. Blancato, J.N. (Environmental Protection Agency, Washington, DC (USA). Office of Health and Environmental Assessment). Apr 1988. 21p. (EPA—600/D-88/070). NTIS, PC A03/MF A01.

Physiologically based pharmacokinetic models provide a useful means of evaluating the impact of different exposure scenarios upon certain components of the risk assessment. In this paper, a physiologically based pharmacokinetic model used for risk-assessment purposes in 1987, was used to determine pulmonary absorption fractions the amount of metabolite formed at various exposure concentrations. The effect of various model parameters such as the metabolic rate constants and the blood to air partition ratios were examined. The paper illustrates the usefulness of such models to test the impact of various assumptions and exposure scenarios upon risk. They are not a replacement for soundly determined data but can be an important adjunct in the interpretation and use of such data.

41593 (PNL—6408-Pt.1) Teratology studies of lewisite and sulfur mustard agents: Effects of lewisite in rats and rabbits: Final report. Hackett, P.L.; Sasser, L.B.; Rommereim, R.L.; Cushing, J.A.; Buschbom, R.L.; Kalkwarf, D.R. (Pacific Northwest Lab., Richland, WA (USA)). 31 Dec 1987. Contract AC06-76RL01830. 65p. NTIS, PC A04/MF A01; GPO Dep. Order Number DE88008303/JAW.

Lewisite was administered to rats and rabbits by intragastric intubation. Maternal animals were weighed periodically, and, at necropsy (20 dg [days of gestation] in rats and 30 dg in rabbits), were examined for gross lesions of major organs and reproductive performances; live fetuses were weighed and examined for external, internal and skeletal defect. In rats, a dose level of 1.5 mg/kg did not induce toxic or teratogenic responses in maternal and fetal body weights and a significant reduction in the number if viable fetuses were evident. In rabbit studies maternal mortality occurred in all but one of the lewisite treatment groups and ranged from 13% to 100% at dose levels of 0.07 and 1.5 mg/kg, respectively. This mortality rate limited the sample size and impaired the detection of statistical significance among treatments. However, at the lowest dose level of the teratology study (0.07 mg/kg, maternal mortality was the only indicator of lewisite toxicity; at the highst dose (0.6 mg/kg), significant findings included 86% maternal mortality, a decrease in maternal body weight gains and an increase in the incidence of fetal stunting, although only a tendency in decreased fetal body weights was observed. These results suggest that maternal mortality was the most important factor in predicting the induction of maternal and fetal effects and, therfore, a "no observable effect level" in maternal animals and their fetuses would be between 1.5 and 2.0 mg/kg in rats and less than 0.07 mg/kg in rabbits. 50 refs., 6 figs., 29 tabs.

41594 **(PNL—6408-Pt.2) Teratology studies of lewisite and sulfur mustard agents: Effects of lewisite in rats and rabbits: Final report: Part 2, Appendices.** Hackett, P.L.; Sasser, L.B.; Rommereim, R.L.; Cushing, J.A.; Buschbom, R.L.; Kalkwarf, D.R. (Pacific Northwest Lab., Richland, WA (USA)). 31 Dec 1987. Contract AC06-76RL01830. 38p. NTIS, PC A03/MF A01; GPO Dep. Order Number DE88008304/JAW.

Lewisite was administered to rats and rabbits by intragastric intubation. Maternal animals were weighed periodically, and, at necropsy (20 dg [days of gestation] in rats and 30 dg in rabbits), were examined for gross lesions of major organs and reproductive performances; live fetuses were weighed and examined for external, internal and skeletal defects. In rats, a dose level of 1.5 mg/kg did not induce toxic or teratogenic responses in maternal animals or their fetuses. At 2.0 mg/kg, 10% maternal mortality, trends in decreased maternal and fetal body weights and a significant reduction in the number of viable fetuses were evident. In rabbit studies, maternal mortality occured in all but one of the lewisite treatment groups and range from 13% to 100% at dose levels of 0.07 and 1.5 mg/kg, respectively. This mortality rate limited the sample size and impaired the detection of statistical significance among treatments. However, at the lowest dose level of the teratology study (0.07 mg/kg), maternal mortality was the only indicator of lewisite toxicity; at the highest dose (0.6 mg/kg), significant findings included 86% maternal mortality, a decrease in maternal body weight gains and an increase in the incidence of fetal stunting, although only a tendency in decreased fetal body weights was observed. These results suggest that maternal mortality was the most important factor in predicting the induction of maternal and fetal effects and, therefore, a "no observable effect level" in maternal animals and their fetuses would be between 1.5 and 2.0 mg/kg in rats and less than 0.07 mg/kg in rabbits. Part 2 contains 6 appendices.

41595 **(PNL—6578) The effects of errors in the measurement of continuous exposure variables on the assessment of risks.** Gilbert, E.S. (USDOE, Washington, DC; Pacific Northwest Lab., Richland, WA (USA)). Jun 1988. Contract AC06-76RL01830. 36p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88013139/JAW.

Exposure variables in epidemiological studies are seldom measured without error. However, it is unusual for such errors to be taken into account in analyzing data, and thus distortion of results may occur. These distorting effects are evaluated for the fitting of linear and log-linear proportional hazard models based on single continuous exposure variable, and are quantified under several sets of assumptions regarding the conditional distributions of the measured exposures given the true exposures, as well as assumptions regarding the true exposure distributions. For a wide range of assumptions, it is found that the most serious consequence of ignoring error is downward bias in the estimation of regression coefficients. In addition, the shape of the dose-response function may be distorted, and variances of estimated parameters may be underestimated. Except for the case of very large errors combined with skewed exposure distributions, tests of the null hypothesis of no effect that ignore error are found to be nearly as powerful as an optimal test, available if the error structure is known. 19 refs., 3 figs., 12 tabs.

41596 **(PNL—6590) Inhalation developmental toxicology studies: Teratology study of n-hexane in mice: Final report.** Mast, T.J.; Decker, J.R.; Stoney, K.H.; Westerberg, R.B.; Evanoff, J.J.; Rommereim, R.L.; Weigel, R.J. (Pacific Northwest Lab., Richland, WA (USA)). May 1988. Contract AC06-76RL01830. 196p. NTIS, PC A09. Order Number DE88012680/JAW.

Gestational exposure to n-hexane resulted in an increase in the number of resorbed fetuses for exposure groups relative to the control group; however, the increases were not directly correlated to exposure concentration. The differences were statistically significant for the 200-ppM with respect to total intrauterine death (early plus late resorptions), and with respect to late resorptions for the 5000-ppM group. A small, but statistically significant, reduction in female (but not male) fetal body weight relative to the control group was observed at the 5000-ppM exposure level. There were no exposure-related increases in any individual fetal malformation or variation, nor was there any increase in the incidence of combined malformations or variations. Gestational exposure of CD-1 mice to n-hexane vapors appeared to cause a degree of concentration-related developmental toxicity in the absence of overt maternal toxicity, but the test material was not found to be teratogenic. This developmental toxicity was manifested as an increase in the number of resorptions per litter for all exposure levels, and as a decrease in the uterine: extra-gestational weight gain ratio at the 5000-ppM exposure level. Because of the significant increase in the number of resorptions at the 200-ppM exposure level, a no observable effect level (NOEL) for developmental toxicity was not established for exposure of mice to 200, 1000 or 5000-ppM n-hexane vapors. 21 refs., 3 figs., 9 tabs.

41597 **Cell-specific activation of chemical carcinogens into mutagens for cultured human and rodent cells.** Huberman, E.; Oravec, C.T.; Jones, C.A. (Argonne National Lab., Div. of Biological and Medical Research, 9700 South Cass Avenue, Argonne, IL 60439 (USA)). pp 475-482 of Genetic toxicology of environmental chemicals. Ramel, C.; Lambert, B.; Magnusson, J. New York, NY; Alan R. Liss Inc. (1986). (CONF-8506373—). Contract W-31-109-ENG-38.

From Genetic toxicology of environmental chemicals, part A: basic principles and mechanisms of action; Stockholm, Sweden (24 Jun 1985).

The objective of in vitro bioassays is to predict the carcinogenic risk to man of exposure to environmental chemicals. Because most chemical carcinogens are mutagenic after appropriate metabolic activation, it is believed that the process of malignant transformation is initiated by "mutational events" in genes that control cell growth and differentiation. Mutagenic activity as measured in in vitro assays is, therefore, widely used as an indicator of carcinogenic hazard from chemicals. These in vitro assays, although useful, have a number of deficiencies: (1) the mutagenic activity of many chemicals is not necessarily related to their carcinogenic effectiveness; (2) the organ to be affected by the carcinogen is usually not indicated; and (3) the response of the bacteria or rodent cells used in these assays to the tested chemicals may be different from that of human cells. The authors have, therefore, been concerned with the need to overcome some of these shortcomings in these assays. In this context, they developed mammalian cell-mediated mutagenesis assays that may circumvent some of these difficiencies.

41598 **The role of metabolism in benzo(a)pyrene carcinogenesis.** Selkirk, J.K.; Merrick, B.A.; Schaeffer, E.L.; Mann, R.C.; Mansfield, B.K. (Biology Div., Oak Ridge National Lab., Oak Ridge, TN 37831 (USA)). pp 483-494 of Genetic toxicology of environmental chemicals. Ramel, C.; Lambert, B.; Magnusson, J. New York, NY; Alan R. Liss Inc. (1986). (CONF-8506373—). Contract AC05-84OR21400.

From Genetic toxicology of environmental chemicals, part A: basic principles and mechanisms of action; Stockholm, Sweden (24 Jun 1985).

Polycyclic aromatic hydrocarbons (PAH) are metabolized by a complex series of microsomal and cytoplasmic enzymes that appears to be the major detoxification pathway for xenobiotics. Highly reactive electrophilic intermediates of PAH such as epoxides and diolepoxides are formed during the detoxification process which react with cellular nucleophiles, including macromolecular targets in the cell. Although the mechanism of action by which the carcinogen/macromolecular interaction initiates the cell toward malignant transformation is uncertain, it is clear metabolism plays a critical role in the carcinogenic and mutagenic effects of PAH. Benzo(a)pyrene is the prototype PAH carcinogen whose metabolism has been extensively investigated and whose metabolites have been tested for carcinogenic activity. A metabolic profile for B(a)P derivatives is shown and consists of a series of oxygenated derivatives with the presumed carcinogenic and mutagenic activity derived primarily from the highly reactive B(a)P-7,8-diol-9,10-epoxide. However, the formation of this reactive electrophile and its interaction with DNA has not allowed the development of a cogent mechanism of action for malignant transformation by this substance.

41599 **Sperm morphology testing in mice.** Wyrobek, A.J.; Watchmaker, G.; Gordon, L. (Lawrence Livermore National Lab., Biomedical Sciences Div., Univ. of California, P.O. Box 5507, L-452, Livermore, CA 94550 (USA)). pp 739-750 of Handbook of mutagenicity test procedures. Kilbey, B.J.; Legator, M.; Nichols, W.; Ramel, C. New York, NY; Elsevier Science Pub. Co. Inc. (1984).

Sperm are important cells in reproductive toxicology because they can be used to assess spermatogenic damage, fertility effects and heritable genetic mutations. The mouse sperm morphology test has been a commonly used sperm test for measuring spermatogenic damage induced by physical or chemical agents; the effects of at least 154 agents have been published. Several other mouse sperm tests have also been developed, yet their usage has been considerably more limited. These include induction of acrosome abnormalities (4 agents), reduction in sperm counts (6 agents), and reduction in sperm motility (5 agents). This chapter describes the methods of the mouse sperm morphology test, the reproductive and genetic implications of chemically induced sperm shape abnormalities, as well as the possible relationship of the mouse sperm morphology test results to carcinogenicity assessment.

41600 **Relationship between surviving clonogenic crypt fraction and animal lethality after cytosine arabinoside (Ara-C) exposure.** Pallavicini, M.G.; Ng, C.R.; Gray, J.W. (Lawrence Livermore Nation Lab., CA (USA)). *Virchows Archiv [Abteilung] B: Cell Pathology;* **46**: 33-42(1984). Contract W-7405-ENG-48.

The authors have measured animal morbidity and the fraction of clonogenic crypt cells following administration of several doses of Ara-C as an infusion over a 24 h period. A nonlinear relationship between reduction in crypt cell survival and Ara-C induced animal lethality was observed, indicating that factors other than crypt cell toxicity contribute to lethality in conventionally-maintained mice. A dose of 100 mg/kg Ara-C reduced the fraction of surviving clonogenic crypt cells to 7×10^{-3} without animal lethality. Maintenance of the animals on acid water before and after Ara-C treatment reduced animal lethality substantially. The magnitude of the reduction of clonogenic crypt cells was incompatible with S-phase specific toxicity as the only cytotoxic mechanism, and suggested that cell recruitment and crypt cell kill due to unbalanced growth are also operative during Ara-C infusion. In addition, the detection of a subpopulation of clonogenic crypt cells which was resistant to killing by Ara-C has important clinical implications and warrants further investigation. These results are substantially different than those found after radiation where, with high radiation doses, the fraction of clonogenic crypt cells decreases exponentially, and where a close relation between reduction in clonogenic crypt cell survival and animal lethality has been established.

41601 **Mercury in our environment.** Malling, H.V.; Wassom, J.S.; Epstein, S.S. *Newsletter of the Environmental Mutagen Society;* **3**: 7-9(1970).

Mercury and mercury-containing chemicals are contaminating the environment of many agricultural and industrial centers. This pollution may represent a health hazard for future generations because of mercury's persistent characteristics and its proven ability to induce genetic changes. 48 references.

5604 Other Environmental Pollutant Effects

REFER ALSO TO CITATION(S) 39593, 39627, 40131, 42134

41602 **(AD-A—191306/0/XAB) Structural alterations in the cornea from exposure to infrared radiation. Final technical memo., 1 July 1977-30 June 1985.** Farrell, R.A.; McCally, R.L.; Bargeron, C.B.; Green, W.R. (Johns Hopkins Univ., Laurel, MD (USA). Applied Physics Lab.). Jul 1985. 40p. (JHU/APL-TG—1364). NTIS, PC A03/MF A01.

This report summarizes the research on the interaction of infrared radiation, especially from CO_2 lasers, with the cornea. The report discusses laser systems, endothelial temperature histories, endothelial damage thresholds, stromal damage, wound repair, epithelial damage from single- and multiple-pulse exposures, and a new thermal damage model based on a phased transition.

41603 **(AD-A—191977/8/XAB) Currents induced in a human being for electromagnetic fields 10 kHz-50 MHz. Final report.** Gandhi, O.P. (Utah Univ. Research Inst., Salt Lake City (USA)). 15 Jan 1988. 52p. NTIS, PC A04/MF A01.

The two tasks undertaken during the period of this project are: 1. Development of a high-resolution thermal model of the human leg and its use to estimate the temperature distribution as a result of the induced high current densities at radio frequencies. 2. Development of a high-resolution, anatomically-realistic, inhomogeneous model of man and its use to calculate the SAR and induced current distributions for frequencies to 100 MHz. It was previously shown that vertically polarized incident plane waves are capable of inducing fairly significant r-f currents in a free-standing human being. Foot currents were found to be proportional to the frequency of incident radiation for the frequency band 0-40 Mega Hz with values as high as 12.7 milli A/(V/m) measured for adult human volunteers at 40 MHz. Recognizing that the induced current is divided equally between the two legs on its way to the ground underneath, fairly high current densities result in the various cross sections of the leg with concommitant high rates of energy deposition (SAR). In particular, due to the predominantly bony nature of the ankle cross section forcing the RF current to flow in an effective 9.5-cm^2 cross section of the high-conductivity tissues, very high current densities (J) and the resulting SARs are set up. These SARs are almost two orders of magnitude larger than the metabolic rates of the tissues and considerably in excess of the ANSI guideline of 8 W/kg for any 1 g of tissue.

41604 **(AD-A—192014/9/XAB) Extremely low frequency (ELF) communications system ecological monitoring program: summary of 1986 progress. Technical report, 1 January-31 December 1986.** Zapotosky, J.E. (IIT Research Inst., Chicago, IL (USA)). Dec 1987. 93p. (IITRI-E—06549-39). NTIS, PC A05/MF A01.

A long-term Ecological Monitoring Program is being conducted to monitor for possible effects from the operation of the U.S. Navy's ELF Communications System to resident biota and their ecological relationships. Monitoring studies were selected through a peer-reviewed, competitive-bidding process in mid-1982 and work on most studies began in late summer of that year. Preliminary activities of the Program consisted of site selection, characterization of critical study aspects, and validation of assumptions made in original proposals. Subsequently, increasing emphasis has been placed on the collection of preoperational and operational data bases at the Michigan and Wisconsin Transmitting Facilities. The data bases are being used to make proposed spatial and/or temporal comparisons of biological and ecological variables. This report summarizes the progress of the Ecological Monitoring Program during 1986.

41605 **(AD-A—192024/8/XAB) Extremely low frequency (elf) communications program: non-ionizing electromagnetic radiation literature evaluation and assessment, 1986-1987 literature review. Final report No. 2.** (Research and Development Labs., Culver City, CA (USA)). Nov 1987. 128p. (RDL—27). NTIS, PC A07/MF A01.

This report deals with the evaluation and assessment of literature concerned with the bioeffects of Extremely Low Frequency Electromagnetic Radiation. The report covers the period from November 1986 to October 1987. The objective of this program is to conduct a thorough and comprehensive review and evaluation, of the published professional literature containing scientific information pertaining to biological effects, including but not limited to human health effects of nonionizing electromagnetic radiation, germane to the Extremely Low Frequency (ELF) Communication Program of the United States Navy. The published professional literature reviewed, evaluated, and assessed includes books, research reports, and articles and papers in peer-reviewed journals that discuss and/or describe biological and health effects of nonionizing electromagnetic radiation in the frequency range of 1-300 Hz. In some instances documents discussing effects of frequencies above 300 Hz were also reviewed. The review and evaluation included both domestic and international literature published in English or other foreign languages.

41606 **(AD-A—192199/8/XAB) Behavioral response of rats exposed to high-power microwave radiation. Interim report, September 1986-January 1987.** Cordts, R.E.; Merritt, J.H.; Erwin, D.N.; Hardy, K.A.; Yochmowitz, M.G. (School of Aerospace Medicine, Brooks AFB, TX (USA)). Feb 1988. 29p. (USAFSAM-TR—87-30). NTIS, PC A03/MF A01.

Emerging high-power microwave technologies require that bioeffects of exposure to this type of radiation be investigated for health and safety considerations. Disruption of animal behavior is reported to be a sensitive indicator of microwave exposure. Three behavioral tasks were chosen for this initial investigation of exposure to U.S. Air Force high-power microwave emitters. The tasks were: (1) single-trail avoidance, (2) water satiation, and (3) rotarod performance. Exposure to high-power microwave radiation from the USAFSAM peak-power simulator significantly affected the single-trail avoidance task. Neither the single-trail avoidance task nor rotarod performance was affected by the Gypsy emitter. However, animals exposed to 9-kW and 11-kW outputs from the USAFSAM emitter spent significantly less time imbibing water postexposure than sham-exposed animals. The most consistent finding in the animals exposed to the Gypsy pulses was that those exposed at 4 m (13.1 ft) spent significantly less time drinking water than those exposed at 1 m (3.28 ft). This paradoxical result may be due to the complex shape of the Gypsy pulse. These data are from the first studies in a series of bioeffects studies of high-power microwave exposure. Other bioeffects investigations using these sources are under way.

41607 **(BNL—40650) International Expert Working Group on environmental, health and safety aspects of photovoltaic energy systems: A workshop report.** (Brookhaven National Lab., Upton, NY (USA)). Jun 1987. Contract AC02-76CH00016. 102p. (CONF-870225—Summ.). NTIS, PC A06/MF A01; 1; GPO Dep. Order Number DE88006160/JAW.

From International expert working group on environmental, health and safety aspects of photovoltaic energy systems; Upton, NY, USA (24 Feb 1987).

Materials and equipment used in photovoltaic cell manufacture may present risks to environment, health and safety (EH&S) because of their inherent toxic, carcinogenic and radiofrequency radiation properties. The future commercial success of the photovoltaics industry will depend on the technical feasibility of producing photovoltaic devices at lower cost and on industry's ability to manage effectively associated EH&S risks. It is important that EH&S risks be examined as the technology matures. Early identification and examination can provide system designers and decision-makers with important flexibility to develop timely and efficient mitigative strategies before large-scale commitment of time and resources. In this way, control costs and risk to health and environment can be minimized, while simultaneously maximizing public acceptance. This report is a summary of the workshop's content and the viewgraphs of presenter's papers. Laboratories presenting information were Brookhaven National Laboratory, the Jet Propulsion Laboratory, Sandia National Laboratory, the Solar Energy Research Institute, and the New Energy Development Organization.

41608 **(PB—88-865498/XAB) Biological effects of electrical- or magnetic-field application. January 1978-March 1987 (Citations from the Life Sciences Collection data base). Report for January 1978-March 1987.** (National Technical Information Service, Springfield, VA (USA)). Jun 1988. 188p. NTIS PC N01/MF N01.

This bibliography contains citations concerning the application of electrical or magnetic fields to organisms. Changes in cell structure, cell shape, metabolism, mitosis, cell orientation, neuron response, germination response, and growth rates are discussed. The effect of electrical or magnetic fields from transmission lines is examined. Biological applications of electric fields cited include genetic transfer, plant cell fusion, and seed disinfection. (This updated bibliography contains 374 citations, none of which are new entries to the previous edition.)

41609 **(PB—88-865506/XAB) Biological effects of electrical- or magnetic-field application. April 1987-May 1988 (Citations from the Life Sciences Collection data base). Report for April 1987-May 1988.** (National Technical Information Service, Springfield, VA (USA)). Jun 1988. 49p. NTIS PC N01/MF N01.

Supersedes PB—87-857355.

This bibliography contains citations concerning the application of electrical or magnetic fields to organisms. Changes in cell structure, cell shape, metabolism, mitosis, cell orientation, neuron response, germination response, and growth rates are discussed. The effect of electrical or magnetic fields from transmission lines is examined. Biological applications of electric fields cited include genetic transfer, plant cell fusion, and seed disinfection. (This updated bibliography contains 82 citations, all of which are new entries to the previous edition.)

57 HEALTH AND SAFETY

REFER ALSO TO CITATION(S) 42419

41610 **(GQ/ME—1988) 3rd Conference on Toxic Substances.** (Quebec Ministere de l'Environnement, Ste-Foy (Canada); Association pour la Prevention de la Contamination Atmospherique, Montreal, Quebec (Canada); Commission de la Sante et de la Securite du Travail, Montreal, Quebec (Canada); Environnement Canada, Ottawa, Ontario. Conservation et Protection). 1988. 228p. (In English and French). (MICROLOG—88-03825; CONF-8804158—). Environment Canada, Publications Section, Terrasses de la Chaudiere, Ottawa, Ont., Canada K1A 0H3; $N/C.

From 3. conference on toxic substances; Montreal, Canada (6 Apr 1988).

A conference was held on toxic substances and ways of monitoring, evaluating, and managing their effects on the environment and on health. Papers were presented in the areas of public policy, detection and measurement, waste storage, disposal, and processing, health risk assessment, and specific studies on individual pollutants. Separate abstracts were prepared for three papers from this conference.

41611 **(KFK—4400) Central Safety Department, annual report 1987.** Kiefer, H.; Koenig, L.A. (comps.). (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Hauptabteilung Sicherheit). Feb 1988. 259p. (In German). NTIS (US Sales Only), PC A12/MF A01. Order Number DE88754184/JAW.

The Central Safety Department is responsible for handling all problems of radiation protection, safety and security of the institutes and departments of the Karlsruhe Nuclear Research Center, for waste water activity measurements and environmental monitoring of the whole area of the Center, and for research and develop-

ment work mainly focusing on nuclear safety and radiation protection measures. The r+d work concentrates on the following aspects: physical and chemical behaviour of biologically particularly active radionuclides, behaviour of HT in the air/plan/soil system, biophysics of multicellular systems, improvement in radiation protection measurement and personnel dosimetry. This report gives details of the different duties, indicates the results of 1987 routine tasks and reports about results of investigations and developments of the working groups of the Department.

58 GEOSCIENCES

5801 Geology And Hydrology

REFER ALSO TO CITATION(S) 39103, 39130, 39219, 39307, 39358, 40492, 41633

41612 **(CEA-CONF—9216) Use of artificial radioactive tracers and radiometric sensors in dynamic sedimentology.** Caillot, A. (Compagnie ORIS Industrie, 91 - Gif-sur-Yvette (France)). Jul 1987. 8p. (In French). (CONF-870627—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88753903/JAW.

From International symposium on radioactivity and oceanography; Cherbourg, France (2 Jun 1987).

Radiometric gages and radioactive tracers allow to-day direct measurements in nature of coastal solid transports. These processes are described here in taking in example the dredging field.

41613 **(INIS-BR—1100) Hydrochemical and isotopic study of the Botucatu aquifer ground waters in Sao Paulo State.** Silva, R.B.G. da. (Sao Paulo Univ. (Brazil). Inst. de Geociencias). 1983. 147p. (In Portuguese). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88702796/JAW.

The process controlling chemical composition of ground water,its origin and apparent age as well as, the natural flow rate of the water in Botucatu aquifer in state of Sao Paulo, Brazil, have been investigated using hydrochemical and environmental isotopic (/sup 18/O, /sup 2/H, /sup 13/C, /sup 14/C) Technics. The main recharge process is assumed to be the infiltration of rain water in the aquifer outcrop area. The progressive confining conditions with the increasing depth of the top of the aquifer layer makes the ground water temperature slowly greater. The recent magnesium and sodium bicarbonated waters changes first to sodium bicarbonated and then to sodium chloride-sulfated waters which are oldest found out in the research area(around 30.000 years ago). The mean Darcy permeability estimated on basis of /sup 14/C and hydraulic gradient data is 2.6x10/sup -5/ m/s. 9 maps

41614 **(LBL—22102) Injection and falloff test analysis to estimate properties of unsaturated fractures.** Mishra, S.; Bodvarsson, G.S.; Attanayake, M.P. (Lawrence Berkeley Lab., CA (USA)). Dec 1986. Contract AC03-76SF00098. 25p. (CONF-861220—9). NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88009831/JAW.

From American Geophysical Union fall meeting; San Francisco, CA, USA (8 Dec 1986).

A new technique for calculating hydraulic properties of unsaturated fractured formations is proposed as an alternative to the common approach involving steady-state analysis of multi-rate gas injection tests. This method is based on graphical analysis of transient pressure data from an injection-falloff test sequence. Flow in a fracture of limited lateral extent, bounded above and below by an impermeable matrix, and intersected by a cylindrical borehole is described by two analytical models. The first model corresponds to early-time infinite acting radial flow, and the second to late-time linear flow. Interpretive equations are derived for computing fracture conductivity and volumetric aperture from early-time data, and fracture width from late-time data. Effects of fracture inclination and gravity are studied numerically, and found to be practically negligible for gas as well as water injection. Analysis of simulated injection-falloff tests using the suggested procedure yields results that agree well with simulator input values. 13 refs., 5 figs.

41615 **(SAND—88-7002) Numerical simulation of ground-water flow in the Culebra dolomite at the Waste Isolation Pilot Plant (WIPP) site: Second interim report.** La-Venue, A.M.; Haug, A.; Kelley, V.A. (Sandia National Labs., Albuquerque, NM (USA); Intera Technologies, Inc., Austin, TX (USA)). Mar 1988. Contract AC04-76DP00789. 371p. NTIS, PC A16/MF A01;1; GPO Dep. Order Number DE88009795/JAW.

This hydrogeologic modeling study has been performed as part of the regional hydrologic characterization of the Waste Isolation Pilot Plant (WIPP) Site in southeastern New Mexico. The study resulted in an estimation of the transmissivity distrubution, hydraulic potentials, flow field, and fluid densities in the Culebra Dolomite Member of the Permian Rustler Formation at the WIPP site. The three-dimensional finite-difference code SWIFT-II was employed for the numerical modeling, using variable-fluid-density and a single-porosity formulation. The modeled area includes and extends beyond the WIPP controlled zone (Zone 3). The work performed consisted of modeling the hydrogeology of the Culebra using two approaches: (1) steady-state modeling to develop the best estimate of the undisturbed head distribution, i.e., of the situation before sinking if the WIPP shafts, which began in 1981; and (2) superimposed transient modeling of local hydrologic responses to excavation of the three WIPP shafts at the center of the WIPP site, as well as to various well tests. Boundary conditions (prescribed constant fluid pressures and densities) were estimated using hydraulic-head and fluid-density data obtained from about 40 wells at and near the WIPP site. The transient modeling used the calculated steady-state freshwater heads as initial conditions. 107 refs., 112 figs., 22 tabs.

41616 **Mt. Blanco revisited: soil-geomorphic implications for the ages of the upper Cenozoic Blanco and Blackwater Draw Formations.** Holliday, V.T. (Univ. of Wisconsin, Madison (USA)). *Geology;* **16**: No. 6, 505-508(Jun 1988).

Mt. Blanco, on the eastern edge of the Southern High Plains of Texas, contains stratigraphic features significant in interpreting the late Cenozoic history of the region and the vertebrate paleontology of the Great Plains; however, the stratigraphic relations are confused in the literature or are unreported. Mt. Blanco is the type locality for the Blanco Formation and the Blanco Local Fauna, which occurs throughout North America and is the type fauna for the Blancan Land Mammal Age in North America. Here also occur exposures of the Blackwater Draw Formation, an extensive (120,000 km²) eolian sheet that is the surficial cover of the region and contains the 1.4 Ma Guaje Ash and several buried soils. A reexamination of the section shows that (1) the Blackwater Draw Formation, an eolian deposit, contains three well-expressed buried soils (5 YR hues, argillic horizons ≧ 1 m thick, Stages III and IV calcic horizons) and the similar regional surface soil (Paleustalf); (2) the Guaje Ash is within the lower Blackwater Draw Formation but is separated from the Blanco Formation, a lacustrine unit, by about 1 m of sediment, including the lowest buried soil; and (3) the lowest buried soil shows a Stage IV calcrete formed at the top of the Blanco Formation and the base of the Blackwater Draw Formation and probably took about 200 ka to form. These new data suggested that deposition of the type Blanco sediments may have ended by about 1.6 Ma or earlier. Since that time, the Blackwater Draw Formation has accumulated episodically; periods of nondeposition are characterized by landscape stability and pedogenesis.

41617 **Low-angle normal faults in the south-central Brooks Range fold and thrust belt, Alaska.** Gottschalk, R.R.; Oldow, J.S. (Rice Univ., Houston, TX (USA)). *Geology;* **16**: No. 5, 395-399(May 1988). Contract AS05-83ER13124.

A north-south structural transect through the south-central Brooks Range, Alaska, exposes three lithologically distinct, fault-bounded packages of rock, all regionally metamorphosed during the Late Jurassic to Early Cretaceous contractional deformation that formed much of the Brooks Range fold and thrust belt. These are, from south to north and structurally highest to lowest, (1) the prehnite-pumpellyite facies ophiolitic rocks of the Angayucham terrane, (2) the low-grade metasedimentary rocks of the Rosie Creek allochthon, and (3) pumpellyite-actinolite to glaucophane-epidote facies metamorphic rocks of the schist belt. The presence of rocks

metamorphosed and deformed at shallow levels of the fold and thrust belt (the Angayucham terrane and Rosie Creek allochthon) lying structurally above rocks representing the deepest exposed levels of the fold and thrust belt (the schist belt) indicates that the imbricate stack is disrupted by south-dipping, low-angle normal faults along the southern margin of the Brooks Range. The authors propose that normal faults developed in response to the uplift of the schist belt and the overlying metasedimentary and ophiolitic allochthons by north-directed thrusting in the late Early Cretaceous. Thrusting resulting in the oversteepening of the imbricate stack, causing compensatory normal faulting along the southern flank of the ramp structure. Normal faults may have provided at least local structural control of the locus of Albian and younger sedimentation in the Koyukuk basin. 34 references.

41618 **Drying of an initially saturated fractured volcanic tuff.** (Sandia National Labs., Albuquerque, NM (US)). pp 55-60 of Multiphase transport in porous media. Eaton, R.; Udell, K.S.; Kaviany, M. New York, NY; American Society of Mechanical Engineers (1988). (CONF-871234—).

From ASME winter meeting; Boston, MA, USA (13 Dec 1987).

The isothermal drying of an initially saturated welded tuffaceous rock was studied experimentally. Gamma-beam densitometry was used to measure the material's effective porosity distribution prior to the drying experiment. It was then used to measure liquid saturation distributions during a 1400 hour drying period. The core selected for study was taken from the Busted Butte outcrop at the Nevada Test Site, part of the Topopah Spring Member of Paintbursh tuff. This specimen contained several microfractures transversely oriented to the direction of the water or vapor migration. These fractures were found to be regions of rapid dryout or low saturation even though they were displaced from the surface over which dry nitrogen was flowing. An imbibition experiment was performed earlier on the same core. In the imbibition experiment the presence of most of these microfractures was detected by discontinuities in the measured saturation curves, which indicated a delay in liquid transport past the microfractures.

41619 **Subsurface water flow simulated for hill slopes with spatially dependent soil hydraulic characteristics.** Sharma, M.L.; Luxmoore, R.J.; DeAngelis, R.; Ward, R.C.; Yeh, G.T. (Commonwealth Scientific and Industrial Research Organization, Wembley (Australia)). *Water Resources Research;* 23: No. 8, 1523-1530(Aug 1987). Contract AC05-84OR21400.

Water flow through hill slopes consisting of five soil layers, with varying spatial dependence in hydraulic characteristics in the lateral plane was simulated by solving Richards' equation in three dimensions under varying rainfall intensities and for two complexities of terrain. By concepts of similar media the variability in soil hydraulic characteristics was expressed by a single dimensionless parameter, the scaling factor α. The moments of log normally distributed α were set as: Mean = 1.0 and standard deviation = 1.0. Four cases of spatial dependence of α in the lateral plane were selected for simulation, using exponential variogram functions ranging in spatial structure from random (no spatial dependence) to large dependence (large correlation lengths). The simulations showed that the rates of subsurface flow from the 30° hillslope, during and following rainfall, were significantly enhanced with an increase in spatial dependence. Subsurface drainage was also increased with increases in rainfall intensity and slop complexity. For hill slopes the relative effects of spatial dependence in soil hydraulic characteristics was smaller with 30° horizontal pitching than without pitching. Hill slopes with a random distribution of hydraulic characteristics provided greater opportunity for soil units with differing water capacities to interact than in cases with spatially correlated distributions. This greater interaction is associated with a greater lag in subsurface flow generation. These studies illustrate some of the expected effects of spatial dependence of soil hydraulic characteristics of the integrated hydrologic response of land areas.

5802 Geophysics

REFER ALSO TO CITATION(S) 39315, 40764

41620 **(AD-A—191288/0/XAB) Engineering and environmental geology of the Indian Wells Valley area. Final report, 17 June 1982-1 September 1987.** Zellmer, J. (Naval Weapons Center, China Lake, CA (USA)). 6 Nov 1987. 40p. (NWC-TP—6854). NTIS, PC A03/MF A01.

The IWV area of southeastern California, is affected by several geologic and geotechnical hazards and problems. These include seismic activity, a limited ground-water resource, flooding, poor soil conditions, slope instability, liquefaction susceptibility, a locally high ground-water table, sewage and toxic waste disposal, and the potential for volcanic activity.

41621 **(AD-A—192022/2/XAB) Further studies of seismic variability at the Shagan River test site. Final report, September 1986-September 1987.** Barker, B.W.; Murphy, J.R. (S-Cubed, San Diego, CA (USA)). Jan 1988. 81p. (SSS-R—88-9213). NTIS, PC A05/MF A01.

Large samples of teleseismic P-wave data recorded from the Shagan River underground explosions were systematically analyzed in an attempt to develop a better quantitative understanding of the sources of m/sub b/ variability observed for these explosions. Results indicate that large differences in station-corrected m/sub b/ residuals between explosions in close proximity are associated with changes in the near-source P-wave propagation paths to teleseismic distances. Projection of the m/sub b/ residuals from seismic stations in continental Europe back into the corresponding P-wave initiation area near the source reveals the existence of an anomalous volume of material located northwest of the test site at a depth of about 100 km. This anomalous volume apparently defocuses energy out of paths to certain stations and redirects this energy into the paths to other stations. Presumably this anomalous volume corresponds to some sharp lateral variation in physical properties, in particular P-wave velocity at this depth. Available geological maps indicate no surface expression of this anomaly. In some cases, the observed patterns of m/sub b/ residual variation can be correlated with semilar patterns of variation in either spectral composite, coda complexity or arrival times of the P wave signals. The sense of these variations in such that enhanced high-frequency energy, decreased coda complexity and delayed arrival times are all associated with positive shift in the m/sub b/ residuals.

41622 **(DOE/ER/13804—1) Progress report for seismic absorption in fluid filled porous rocks as a function of seismic frequencies, pressure and temperature.** (Colorado Univ., Boulder (USA). Dept. of Geological Sciences). [1988]. Contract FG02-87ER13804. 66p. NTIS, PC A04/MF A01;1; GPO Dep. Order Number DE88011512/JAW.

The first 8 months have been used mainly to design and develop equipment. After carefully exploring various sensing technologies we have opted for measuring the minute displacements involved in the Q measurements by optical interferometry. The reason for this decision stems only partly from our prejudice (because of our experience) toward optics, but more importantly from the inherent calibration when using laser light of a known wavelength. We have further developed the optical parts and the electronics of our high precision interferometer, having reached the sensitivity needed for our measurements. In adapting this technology to a high pressure and high temperature environment we explored the use of optical fibers and constructed a single mode fiber interferometer and introduced an optical fiber into a high-pressure environment. The interferometer functioned satisfactorily and the high-pressure feedthrough failed at 300 MPa, 3 times the value of the pressure at which we expect to do our measurements.

41623 **(NUREG/CR—3145-Vol.6) Geophysical investigations of the western Ohio-Indiana region: Annual report, October 1986-September 1987.** Schwartz, S.Y.; Christensen, D.H.; Lay, T.; Cohee, B.P. (Michigan Univ., Ann Arbor (USA). Dept. of Geological Sciences). Feb 1988. 35p. NTIS, PC 04 - GPO;1. Order Number TI88010123/JAW.

Earthquake activity in the Western Ohio--Indiana region has been monitored with a precision seismograph network consisting of nine staions located in west-central Ohio and four stations located in Indiana. One local and eleven near-regional earthquakes have been recorded during this report period. The local event had a duration magnitude of 0.7 and was not large enough to be felt. Its location is very close to the larger (m/sub b/ = 4.5) 12 July 1986 St. Marys, Ohio earthquake. Many of the regional events were felt with magnitudes ranging from m/sub bLg/ = 2.7--4.9. The two largest of these events (27 March 1987 in northeastern Tennessee, m/sub b/Lg = 4.2, and 10 June 1987 in southeastern Illinois, m/sub b/Lg = 4.9) had minor damage reported in each case. P/sub n/ travel time residuals, computed for all well-recorded regional events since deployment of the Anna Seismic Network, display a strong azimuthal dependence with positive residuals (slow observed arrival times) obtained from events with northeasterly through southerly back azimuths and negative residuals (fast observed arrival times) from events with westerly back azimuths. This pattern has large residuals, but is similar to the azimuthal dependence displayed in the teleseismic P-wave residuals, supporting an interpretation that shallow structural heterogeneity is responsible for the P/sub n/ residual pattern. 10 refs., 10 figs., 4 tabs.

41624 **(NUREG/CR—5045) Kansas-Nebraska seismicity studies using the Kansas-Nebraska microearthquake network: Final report.** Steeples, D.W.; Hildebrand, G.M.; Bennett, B.C.; Miller, R.D.; Chung, Y.; Knapp, R.W. (Kansas Geological Survey, Lawrence (USA)). Mar 1988. 71p. NTIS, PC A05/MF A01 - GPO;1. Order Number TI88010495/JAW.

The Kansas Geological Survey (KGS) operates a 15 station seismograph network with stations located in northeast Kansas and southeast Nebraska. The network is supported in part by funding from the United States Nuclear Regulatory Commission (NRC). This report discusses operation of the network and summarizes the results of research that allows a better understanding of the seismicity of the region and the link between the seismicity and the tectonic setting of the region. 29 refs., 12 figs., 4 tabs.

41625 **(NUREG/CR—5123) Studies of the pattern and ages of post-metamorphic faults in the Piedmont of Virginia and North Carolina.** Glover, L. III; Costain, J.K.; Coruh, C. (Nuclear Regulatory Commission, Washington, DC (USA). Div. of Engineering; Virginia Polytechnic Inst. and State Univ., Blacksburg (USA). Dept. of Geological Sciences). Apr 1988. 60p. NTIS, PC A04/MF A01 - GPO. Order Number TI88009101/JAW.

A geologic corridor from the Blue Ridge to the eastern Piedmont of Virginia is integrated into a tectonic model and extrapolated downward 10-15 km by means of seismic reflection and gravity studies. The Blue Ridge appears to be a hinge zone that faced a rift-generated Iapetus Ocean. An eastern continent with an Eocambrian and Cambrian magmatic arc and sediments of the same age, collided with the North American continental margin in the middle and late Ordovician. Subsequent Devono-Mississippian and Mississippian-Permian orogenesis continued to drive thin thrust nappes onto North America. Early Mesozoic rift basins record the beginning of the Atlantic basin and, from Middle Jurassic to Present, the margin of North America was covered by Coastal Plain sediments. Several constrained hypocenters of the central Virginia seismic zone, adjacent to a reflection profile, show an apparent relation to structure. We tentatively conclude that flat and ramp faults formed during Paleozoic nappe emplacement are currently being reactivated. The reactivation may be largely aseismic on the old thrust faults, but seismicity appears to be related to high angle transcurrent faults where new rock breakage may be occurring. 125 refs., 28 figs., 2 tabs.

41626 **(SV-UG—1988-4) Magnetotelluric measurement along NW-SE profile in the Siljan area.** Pedersen, L.B.; Zhang, P.; Rasmussen, T.R. (Swedish State Power Board, Vaellingby). 31 Dec 1987. 103p. NTIS (US Sales Only), PC A06/MF A01. Order Number DE88753756/JAW.

As more and more data are collected the technique for interpreting MT measurements have correspondingly improved. With the acquisition of the latest data set it is apparent that it is necessary to take into account near-surface effects when interpreting deeper resistivity structures. When seen on a gross scale the initial interpretation is still correct, however, the details differ when using the refined techniques. After compensating for near surface effects the following conclusions can be made about the deeper resistivity structure: a/There is an impact generated anomaly present down to depths of 15-20 km. b/The lower crust (deeper than 15-20 km) and the upper mantle are laterally homogeneous. An overview of the results where the impact generated anomaly is clearly seen with lower resistivities in the upper crust. The Gravberg well is located just south of station 61 and the low near surface resistivities in the vicinity of station 85 correspond to the sedimentary ring. Another striking result is the strong indications of electrical anisotropy in the upper mantle and the upper crust between 6 and 15-20 km depth. The anisotropy is strongest in the direction N15/sup o/E which shows the best conductivities and N105/sup o/E which shows the poorest conductivities. An explanation for the anisotropy and the low resistivities related to the impact are that fluid filled fracture systems are present in the crust and upper mantle. If this is the case in the upper crust then this implies that fracture systems are present oriented in the direction N15/sup o/E. This is almost perpendicular to the direction expected from the estimated stress field in the region. This implies that fracture systems can survive changes in the state of stress. (authors).

41627 **Impact on the earth, ocean and atmosphere.** Ahrens, T.J.; O'Keefe, J.D. (Seismological Lab. 252-21, California Institute of Technology, Pasadena, CA (US)). pp 13-32 of Hypervelocity impact. Anderson, C.E. Elmsford, NY; Pergamon Books Inc. (1987). (CONF-861091—).

From Hypervelocity impact symposium; San Antonio, TX, USA (21 Oct 1986).

Several hundred impact craters produced historically and at times as early as 1.9 x 10/sup 9/ years ago with diameters in the range 10/sup -2/ to 10/sup 2/ km are observed on the surface of the earth. Earth-based and spacecraft observations of the surfaces of all the terrestrial planets and their satellites, as well as many of the icy satellites of the outer planets, indicated that impact cratering was a dominant process on planetary surfaces during the early history of the solar system. Moreover, the recent observation of a circumstellar disk around the nearby star, β-Pictoris, appears to be similar to the authors' own hypothesized protosolar disk. A disk of material around our sun has been hypothesized to have been the source of the solid planetesimals from which the earth and the other planets accreted by infall and capture. Thus it appears that the earth and the other terrestrial planets formed as a result of infall and impact of planetesimals. Although the present planets grew rapidly via accretion to their present size (in —10/sup 7/ years), meteorite impacts continue to occur on the earth and other planets. Until recently meteorite impact has been considered to be a process that was important on the earth and the other planets only early in the history of the solar system. This is no longer true. The Alvarez hypothesis suggests that the extinction of some 90% of all species, including 17 classes of dinosaurs, is associated with the 1 to 150 cm thick layer of noble-element rich dust which is found all over the earth exactly at the Cretaceous-Tertiary boundary. The enrichment of noble elements in this dust is in meteorite-like proportions. This dust is thought to represent the fine impact ejecta from a —10 km diameter asteroid interacting with the solid earth. The Alvarez hypothesis associates the extinction with the physics of a giant impact on the earth.

5803 Mineralogy, Petrology, And Rock Mechanics

REFER ALSO TO CITATION(S) 40246

41628 **(ANL—87-56) Weight losses of marble and limestone briquettes exposed to outdoor environments in the eastern United States.** Youngdahl, C.A. (Argonne National Lab., IL (USA)). Aug 1987. Contract W-31109-ENG-38. 28p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88010383/JAW.

Weight losses of marble and limestone samples exposed to outdoor environments at field sites in the eastern United States have been monitored in studies initiated in 1984. The prodcedures

are described, and the results are tabulated and discussed. A rate of marble loss approximately equivalent to 16 μm of surface recession per year was found in North Carolina, and losses of this order were also observed in New Jersey, New York, and Washington, DC. Limestone weight losses were much higher than for marble in the first year; loss of extraneous materials from the porous limestone appeared to be a likely contributor to the overall loss. The rate of limestone loss diminished in the second year, though it continued to be higher than for marble. Exposures are continuing in a planned 10-yr program of tests. 8 refs., 3 figs., 5 tabs.

41629 **(DOE/NV/10412—T4) Elastic-plastic deformation of geopressured reservoir rock.** Sun, Ming-Shen Martin. (Texas Univ., Austin (USA)). May 1988. Contract FC07-85NV10412. 85p. NTIS, PC A05/MF A01;1; GPO Dep. Order Number DE88011089/JAW.

Cyclical triaxial loading tests conducted on the Gladys McCall sandstone show that the material exhibits an elastic-plastic deformation behavior. A damage mechanics model and a small strain plasticity model may be used to describe the materials compaction. Ultimate strengths of this material at various confining pressures and pore pressures were measured in order to determine a failure surface in effective stress space. The effects of confining pressure and pore pressure on the mechanical properties of the material may be determined from the triaxial test results. 12 refs.

41630 **(SAND—88-1623) Significance of drilling- and coring-induced fractures in Mesaverde Core, Northwestern Colorado.** Lorenz, J.C.; Finley, S.J. (Sandia National Labs., Albuquerque, NM (USA)). Jun 1988. Contract AC04-76DP00789. 36p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88012413/JAW.

Several types of mechanically induced fractures occur in Mesaverde core form the US Department of Energy's Multiwell Experiment wells. Two types of fractures have significance to the determination of in situ stresses. (1) Scribe-line fractures originate at orientation grooves on the surface of the core and are initiated by scribing knives in the core barrel minutes after the core is cut free from the surrounding rock. In sandstone, they strike parallel to the maximum in situ horizontal stress direction that has been determined in these wells by anelastic strain recovery measurements. (2) Drilling- or coring-induced petal and petal-centerline fractures form just below the advancing core bit. Their strike is controlled primarily by the in situ stress, but locally may be influenced by shear stress created by bit rotation. Large shear stress may reorient petal fracture strikes in the direction of bit rotation, oblique to the maximum in situ horizontal stress direction. In most situations, however, orientations of these two types of fractures may be used to determine the orientation of the in situ stresses relative to natural fractures, and ultimately whether a stimulation fracture will parallel or intersect natural fracture permeability systems in a reservoir. 15 refs., 17 figs.

41631 **Evolution of magmatic AFM mineral assemblages in granitoid rocks: the hornblende + melt = biotite reaction in the Liberty Hill pluton, South Carolina.** Speer, J.A. (Virginia Polytechnic Institute and State Univ., Blacksburg (USA)). *American Mineralogist;* 72: No. 9-10, 863-878(Sep-Oct 1987). Contract AS05-76ET28387;AC05-78ET27001.

The Liberty Hill pluton comprises a central, coarse-grained edenite + biotite granitoid facies grading to a biotite, pargasite + biotite, or muscovite + biotite granitoid marginal facies. The replacement of amphibole by biotite, mineral compositions, and liquid variation diagrams for the Liberty Hill help determine the AFM mineral-crystallization reactions in the Liberty Hill pluton. These reactions evolved from liquid = amphibole to liquid = biotite with an intervening liquid + amphibole = biotite reaction resulting from either (1) movement along the amphibole-biotite liquidus boundary from the even, liquid = amphibole + biotite, to the odd, liquid + amphibole = biotite, crystallization reaction with decreasing temperatures or (2) movement of the liquid composition from the amphibole field into the biotite field. The liquid + amphibole = biotite reaction involved additional phases; the full reaction may have taken the form liquid 1 + amphibole + ilmenite = biotite + quartz + anorthite + K-feldspar + titanite + magnetite + liquid 2, where the liquid is the interstitial melt. The extended crystallization history to lower temperatures and higher water activities at the margins of the pluton allowed the reaction to exhaust the amphibole before the liquid; the subsequent liquid = biotite crystallization reaction produced the biotite granitoid facies. Locally, muscovite crystallized according to the reaction liquid = muscovite + biotite, producing the muscovite + biotite facies. The pluton is intruded by a finer-grained biotite granitoid believed to be derived from interstitial melt of the coarser-grained granitoids. This derivation explains why biotite is the only AFM mineral in the finer-grained granitoids and why biotites from all Liberty Hill granitoids are generally similar in composition.

5804 Geochemistry

REFER ALSO TO CITATION(S) 39103, 39112, 40478, 41366

41632 **(AD-A—191824/2/XAB) ^{238}Pu heat source in marine coastal sediment: formation of a protective concretion.** Weiss, H.V.; Pavone, D. (Naval Ocean Systems Center, San Diego, CA (USA)). 1986. 8p. NTIS, PC A02/MF A01.

Pub. in Applied Geochemistry, Vol. 1, No. 6, 691-696(1986).

The effect of the marine environment upon a vented iridium-encapsulated plutonium-238 heat source was investigated. The heat source was emplaced in coastal submarine feldspathic sediment. In less than a month it became encased in a rock-like concretion. The capsule was cemented initially with a white deposit of anhydrite, a mineral identified with high temperature deep-sea springs. As the concretion increased in thickness, sedimentary particles were incorporated by the cementing agent. A non-porous barrier was formed such that decay product He was impeded from escape. This property protected the heat source against intrusion by the corrosive marine waters. As determined by neutron activation, the major and minor elements within the coastal sediment, various fractions of the concretion, and certain discrete entities within or on the surface of the concretion, are included.

41633 **(DOE/ER—13767-1) Sedimentologic and diagenetic history of the Mission Canyon Formation (Mississippian) and stratigraphic equivalents, southwestern Montana and east-central Idaho and determination of rare earth element abundances in diagenetic carbonates: Technical progress report No. 1, July 15, 1987-July 14, 1988.** Dorobek, S.L. (Texas A and M Univ., College Station (USA)). 15 Mar 1988. Contract FG05-87ER13767. 22p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88010246/JAW.

Significant progress has been made within the first eight months of the project period, July 15, 1987 to March 15, 1988. Detailed field descriptions of measured stratigraphic sections have allowed documentation of some of the sedimentologic characteristics of the Mission Canyon platform-to-basin transition. In addition, approximately 450 petrographic thin sections have been made from rock samples collected in the field and sampling has begun for stable isotopic, trace elements, fluid inclusion, and rare earth element analyses.

41634 **(PB—88-175906/XAB) Helium- and lead-isotope geochemistry of oceanic volcanic rocks from the East Pacific and South Atlantic. Doctoral thesis.** Graham, D.W. (Woods Hole Oceanographic Institution, MA (USA)). 1987. 267p. (WHOI—87-36). NTIS, PC A12/MF A01.

Glassy basalts erupted at young Pacific seamounts and along the mid-ocean ridge in the South Atlantic, and volcanic rocks from the island of St. Helena were studied for He and Pb isotopes. (U+TH)/He ages of seamount alkali basalts were determined from the isotope disequilibrium of (3)He/(4)He between He trapped in vesicles and that dissolved in the glass phase. The method allows alkalic lavas to be dated in the age range of 103 to 106 years. Tholclites at the EPR seamounts have He, Pb, Sr and Nd isotope compositions indistinguishable from MORB, while associated alkali basalts show more radiogenic signatures. The low (3)He/(4)He in the vesicles of alkali basalts (1.2-2.6 RA), their low helium concentrations, and systematic variations with extent of differentiation suggest that magmatic processes influence (3)He/(4)He in these alkalic lavas. Pb-Sr-Nd isotopes at Shimada seamount (17 deg N, 117 deg W) indicate the presence of enriched mantle beneath the East Pacif-

ic which resembles that beneath Samoa. Low (3)He/(4)He (4-5 RA) appears to be an inherent characteristic of the component. Much of the South Atlantic ridge axis displays (3)He/(4)He lower than normal MORB, and is apparently contaminated by off-axis hotspots. He-Pb systematics along the ridge suggest that (3)He/(4)He at St. Helena is less than MORB, consistent with values measured by in vacuo crushing of olivine and pyroxene in St. Helena rocks (approx. 5.8 RA).

41635 **Phlogopite: high temperature solution calorimetry, thermodynamic properties, Al-Si and stacking disorder, and phase equilibria.** Clemens, J.D.; Circone, S.; Navrotsky, A.; McMillan, P.F.; Smith, B.K.;; Wall, V.J. (Arizona State Univ., Tempe (USA)). *Geochimica et Cosmochimica Acta;* **51**: No. 9, 2569-2578(Sep 1987). Contract AC02-80ER10765;FG02-85ER13437.

Two structural features complicate the thermodynamics of synthetic and natural micas. The first is a varying degree of tetrahedral Al-Si disorder. Raman spectroscopic study of phlogopite synthesized above 600°C suggests a disordered Al-Si distribution. Calculations of the P-T locus of the geologically important equilibrium: Phl + 3Qtz = 3En + Sa + H_2O, using the authors thermochemical data, agree within experimental error with the results of calculations based on the best available phase equilibrium data only if a tetrahedrally disordered phlogopite is assumed. Such calculations are very sensitive to uncertainties in ΔH° and ΔHG°, and reversed phase equilibrium experiments remain essential to obtaining reliable estimates of thermodynamic properties. In contrast to these Al-Si disordered phlogopites, some biotites of low temperature parageneses (<600°C) may have substantial Al-Si order. A variable Al-Si distribution has a substantial effect on the configurational entropy and therefore on the free energy of the mica in question. The second structural complication is stacking disorder, which is present in phlogopite synthesized at 650°C but not in the 850°C sample. The enthalpy difference between these two samples, determined by solution calorimetry, is smaller than the experimental uncertainty of +/- 1.0 kcal mol^{-1}. Thus there appears to be little driving force for ordering, and micas with disordered stacking sequences may persist in many geologic environments.

41636 **Thermodynamics of NaOH(aq) in hydrothermal solutions.** Pabalan, R.T.; Pitzer, K.S. (Univ. of California, Berkeley (USA)). *Geochimica et Cosmochimica Acta;* **51**: No. 4, 829-837(Apr 1987). Contract AC03-76SF00098.

Apparent molar volumes and osmotic coefficients of NaOH solutions, calculated from critically evaluated literature data on volumes and vapor pressures, were used to fit the Pitzer equations to yield ion-interaction parameters as a function of temperature and pressure. These parameters allow the calculation of osmotic activity coefficients from 0-350°C, saturation pressure to about 400 bars and 0-10 molal NaOH, and volumetric properties at saturation pressure over the same temperature and concentration range. Because the parameters for osmotic and activity coefficients above 300°C are based on less precise data, and because of possible ion-pairing above this temperature, calculated values above 300°C are considered only as best estimates available at this time. Partial molar volumes at infinite dilution calculated for NaOH are combined with literature data for NaCl, HCl, and H_2O to yield the pressure dependence of the ionization of water to 200°C, and are also combined with the potentiometric data of SWEETON et al. (1974) on the ionization of water to calculate the infinitely dilute partial molar volume of HCl to 300°C. Specific volumes of NaOH solutions at saturation pressure and up to 350°C are also calculated and tabulated.

5805 Oceanography

REFER ALSO TO CITATION(S) 41360, 41365

41637 **(DOE/ER/60334—T1) The flux and recycling of bioactive substances in the surface sediments of the deep basins off southern California: Progress report.** Jahnke, R.A. (Scripps Institution of Oceanography, San Diego, CA (USA)). Jan 1988. Contract FG05-85ER60334. 10p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88007999/JAW.

Goals of this project are to develop an understanding of the processes that recycling biogenic debris reaching the seafloor and to quantitatively determine the role of seafloor recycling in oceanic biogenic cycles. This includes evaluating the rate at which biogenic elements are released from the sediments due to organic matter decomposition as well as the rate at which certain biogenic elements are consumed in the sediments such as the consumption of 0_2 by oxic respiration and NO_3/sup {minus}/ by denitrification. Benthic fluxes were estimated via the Bottom Lander. Results were combined with results from other West-coast researchers and a preliminary organic carbon budget for Santa Monica Basin was estimated. During the past year, benthic fluxes have been measured by a new in situ benthic chamber instrument and a shipboard incubation method. In addition, sediment cores were recovered from a wider region of the basin's seafloor. Pore waters were extracted from these cores and analyzed for biogenically important elements. Results permit a more accurate estimate of recycling at the seafloor of Santa Monica Basin to be made. Results are described. 8 figs., 1 tab.

64 PHYSICS I

6401 Astrophysics And Cosmology

REFER ALSO TO CITATION(S) 41112, 41115, 41692, 41693, 41744, 41841, 41903, 42213, 42350

41638 **(AD-A—190921/7/XAB) DMSP dosimetry data: a space measurement and mapping of upset-causing phenomena.** Mullen, E.G.; Gussenhoven, M.S.; Lynch, K.A.; Brautigam, D.H. (Air Force Geophysics Lab., Hanscom AFB, MA (USA)). Dec 1987. 6p. (AFGL-TR—88-0022). NTIS, PC A02/MF A01.

Pub. in IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science, Vol. NS-34, No. 6, 1251-1255(Dec 1987).

Data from the DMSP/F7 satellite-dosimeter star-event counters are presented. The DMSP dosimeter star-event counters measure the number of pulses that exceed set energy deposition levels (40 MeV for three detectors and 75 MeV for the fourth detector) behind four different thicknesses of aluminum shielding. The term star event is used because linear-energy-transfer depositions above 40 MeV can be produced by high-energy proton or heavy-ion interactions with nuclei in the detector creating a star-type release of energetic secondaries. The energy deposition that creates the high-energy pulses in the detectors can come either directly from incident cosmic rays, directly from high-energy protons that traverse long path lengths in the detector volume, indirectly from nuclear reactions in the detector created by incident high-energy protons, or indirectly from nuclear reactions in the vicinity of the detector which create recoiling nuclei that deposit energy in the detector. These nuclear stars and direct energy pulses create single event upsets (SEUs) in microelectronic components in the near-Earth space environment. Properties of the star channel of the dosimeter on DMSP/F7, the star-count maps of the 840-km region of space, and their relation to upset phenomena are described.

41639 **(AD-A—191497/7/XAB) Infrared astronomy at extremely faint light levels in support of the LAIRTS program. Final technical report, 1 February 1985-30 September 1987.** Thuan, T.X. (Virginia Univ., Charlottesville (USA). Dept. of Astronomy). Sep 1987. 4p. NTIS, PC A02/MF A01.

Near-infrared observations were obtained for a large sample of dwarf irregular galaxies, dwarf elliptical and blue compact dwarf galaxies. Near-infrared photometry was obtained for radio sources discovered in a deep VLA radio survey. Near-infrared observations were also obtained for the first brightest galaxy in a sample of nearby clusters. A large redshift survey, using the 21-cm hydrogen line, of dwarf galaxies in the Northern Hemisphere was completed. Work was done to understand the stellar populations and star formation are presently occurring.

41640 **(CEA-CONF—9206) SN 1987A light curve.** Schaeffer, R. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Service de Physique Theorique). 1987. 7p. (CONF-8707168—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88753594/JAW.

From ESO workshop on the SN 1987A; Garching, F.R. Germany (6 Jul 1987).

The observation of the SN1987A light curve shows the latter to be highly unusual. The rise of the optical curve within a few hours and the very rapid UV decline shows a strong cooling in the early phase. The luminosity plateau was quite low, about 3 to 4 magnitudes fainter than expected whereas the photospheric temperatures stabilized at the value where the electrons recombine. These properties can be explained (Schaeffer, Casse, Mochkovitch, Cahen 1987) by the unusual progenitor of SN1987A, and are quite similar to the supernova explosions studied earlier (Schaeffer, Casse, Cahen 1987) of stars that are massive but of quite small a size. In the latter case, various energy sources, the energy deposited by the shock, or the /sup 56/Ni decay, or the recombination energy of the electrons, can be responsible for the light emission.

41641 **(CEA-CONF—9228) Galaxies, clusters and fluctuations.** Schaeffer, R. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Service de Physique Theorique). 1987. 18p. (CONF-8706306—). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88753598/JAW.

From Large scale structures of the universe; Balatonfuered, Hungary (15 Jun 1987).

The luminosity function of galaxies and clusters as well as their correlations can be calculated assuming the many-body correlation functions are scale invariant. The same hypothesis leads to predictions on the fractal dimension of the galaxy distribution. The latter is found to be bifractal that is characterized by two dimensions $D=3-\gamma$ in the cluster region, and $D=(3-\gamma)$ in the nearly empty regions, α being the index introduced by Schechter for the galaxy luminosity function. Finally, the same models lead to predictions for the evolution of the cluster and x-ray luminosity functions, as well as for the Sunyaev-Zeldovich effect due to all virialized clusters, which is found to be large and to produce fluctuations of order 10/sup -5/ at sub-arc minute scalar in the microwave background.

41642 **(CEA-CONF—9286) Quasi-static evolution of a force-free magnetic field applications to the theory of stellar flares and coronal heating.** Aly, J.J. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Inst. de Recherche Fondamentale (IRF)). 1987. 5p. (CONF-8707176—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88753910/JAW.

From Conference on activity in cool star envelopes; Tromso, Norway (1 Jul 1987).

We consider in the highly conducting half-space an x-invariant arcade force-free field which is evolving in a quasi-static way as a consequence of a velocity field imposed on a boundary plane. We show in particular that, when the shear exceeds a critical value, the configuration becomes metastable whith respect to non-linear perturbations which change the topology of the field lines, but preserve the magnetic fluxes.

41643 **(CEA-CONF—9293) Particle acceleration in the interplanetary medium.** Engelmann, J.J. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Inst. de Recherche Fondamentale (IRF)). Jul 1987. 26p. (In French). (CONF-8707175—). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88753913/JAW.

From Biannual meeting of the French Physical Society; Strasbourg, France (6 Jul 1987).

Variations in solar wind properties are dominated by a number of high speed streams. By interacting with the quiet wind, the fast streams give rise in the first case to a travelling shock wave, in the second case to a pair of forward and backward shock waves, by which the interaction region, corotating with the sun, is bounded. Two acceleration mechanisms are invoked to account for the energetic ion flux increases: 1) The first order Fermi process, whereby particles increase their energy by compression between converging magnetic scattering centers, located upstream and downstream of the shock. 2) The shock drift mechanism. The composition and the spectrum of the accelerated ions suggest that they probably originate from the suprathermal tail of the solar wind distribution.

41644 **(CEA-CONF—9322) Cluster evolution.** Schaeffer, R. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Service de Physique Theorique). 1987. 7p. (CONF-8706319—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88753931/JAW.

From 3. IAP astrophysics meeting on high redshift and primewal galaxies; Paris, France (29 Jun 1987).

The galaxy and cluster luminosity functions are constructed from a model of the mass distribution based on hierarchical clustering at an epoch where the matter distribution is non-linear. These luminosity functions are seen to reproduce the present distribution of objects as can be inferred from the observations. They can be used to deduce the redshift dependence of the cluster distribution and to extrapolate the observations towards the past. The predicted evolution of the cluster distribution is quite strong, although somewhat less rapid than predicted by the linear theory.

41645 (ESA-SP—278, pp vp) **Diversity and similarity of comets.** Delsemme, A.H. Sep 1987. NTIS, PC A99/MF E03. (ETN—88-91972; CONF-8704138—).

From Conference on similarities and dissimilarities of comets; Brussels, Belgium (6 Apr 1987).

The evolution of comets from an early stage where they were all similar, to the later diversity is reviewed. The elemental abundances of all pristine comets are likely to be primitive, that is in solar abundance ratios for all elements including C, N, O, S, but with the exception of H (and assumedly He and Ne) that are severely depleted. The solid phase was originally in very fine grains, typically 0.1 micron or less, eventually sintered into larger grain clusters. The volatile phase contains H, C, N, O, and S molecules frozen in the pores of the grain clusters; cosmic ray plus solar irradiation changes the volatile to refractory ratio of the crust. Differences in dust tails, in plasma tails, in photometry between young and old comets, and in the variable carbon depletion of the gas phase seem to be induced by the decay processes.

41646 (ESA-SP—278, pp vp) **Foreshock region upstream from the Comet Halley bow shock.** Fuselier, S.A.; Anderson, K.A.; Balsiger, H.; Glassmeier, K.H.; Goldstein, B.E.; Neugebauer, M.; Rosenbauer, H.; Shelley, E.G. (Lockheed Aircraft Corp., Palo Alto, CA (USA)). Sep 1987. NTIS, PC A99/MF E03. (ETN—88-91972; CONF-8704138—).

From Conference on similarities and dissimilarities of comets; Brussels, Belgium (6 Apr 1987).

A few hours prior to the crossing of the Comet Halley bow shock, the Giotto spacecraft intermittently encountered an electron foreshock region. The electron foreshock is characterized by magnetic connection to the cometary bow shock and increased field aligned electron heat flux directed away from the bow shock. A similar region was intermittently encountered by the ICE spacecraft prior to its crossing of the Giacobini-Zinner bow wave. During periods of magnetic connection with the Halley bow shock, enhanced magnetic field fluctuations were observed. These enhancements are interpreted as indirect evidence of an ion foreshock in the electron foreshock. No clearly identifiable backstreaming protons are observed during these periods of magnetic connection, however, because it may be difficult to separate a backstreaming population from the cometary pick-up proton population already present in the upstream region.

41647 (ESA-SP—278, pp vp) **Evidence for first polymer in Comet Halley: Polyoxymethylene.** Huebner, W.F.; Boice, D.C.; Sharp, C.M.; Korth, A.; Lin, R.P.; Mitchell, D.L.; Reme, H. (Centre d'Etude Spatiale des Rayonnements, Toulouse (France)). Sep 1987. NTIS, PC A99/MF E03. (ETN—88-91972; CONF-8704138—).

From Conference on similarities and dissimilarities of comets; Brussels, Belgium (6 Apr 1987).

The RPA2-Positive Ion Cluster Composition Analyzer (PICCA) on the Giotto spacecraft detected 5 mass peaks with regular spacing of 15 amu up to approximately 120 amu. Starting at 45

amu, the peaks decrease in intensity with increasing mass. Within their half-width they are in good agreement with dissociation products of formaldehyde polymer (POM). A production sequence in which cosmic radiation formed POM from water and carbon monoxide on grains that were aggregated into cometesimals is suggested. Other polymers, possibly containing CN, may also exist. Observations suggest that at least some of the H-, C-, and O-containing dust particles detected by the Particle Impact Analyzer (PIA) on board the Giotto spacecraft and its equivalent on the VEGA-1 and -2 spacecraft contain POM. The properties of POM are consistent with many of the unexpected observations in the coma.

41648 (ESA-SP—278, pp vp) **Spatial distribution of O(supra 1D) from Comet Halley.** Roesler, F.L.; Scherb, F.; Magee-Sauer, K.; Harlander, J.; Reynolds, R.J.; Oliversen, R.J. (Wisconsin Univ., Madison (USA)). Sep 1987. NTIS, PC A99/MF E03. (ETN—88-91972; CONF-8704138—).

From Conference on similarities and dissimilarities of comets; Brussels, Belgium (6 Apr 1987).

Images of Comet Halley in (OI)6300A emission obtained using a 150 mm Fabry-Perot spectrometer in the imaging mode were combined with spectra taken in the scanning mode to deduce the distribution of cometary O(1D) within a 10 arc min field of view centered on the comet head. The 10 km/sec bandpass of the system allows the distribution to be measured with little contamination from airglow O(1D) and cometary NH_2 lines in the nearby spectrum. The results are modeled to provide photodestruction scale lengths for cometary H_2O and OH, the predominant parents of O(1D). Results are compared with other experimental and theoretical results.

41649 (ESA-SP—278, pp vp) **Analysis of the coma outburst of Comet Halley, March 24 to 25 (UT), 1986.** Rettig, T.W.; Kern, J.R.; Ruchti, R.; Baumbaugh, B.; Baumbaugh, A.E.; Knickerbocker, K.L.; Dawe, J. (Australian National Univ., Coonabarabran). Sep 1987. NTIS, PC A99/MF E03. (ETN—88-91972; CONF-8704138—).

From Conference on similarities and dissimilarities of comets; Brussels, Belgium (6 Apr 1987).

Observations using a fast CCD and custom built video data acquisition system at the Nasmyth focus of a 2.3 m telescope produced digitized images of Comet Halley. Nightly variations in inner coma brightness and shape are noted. On March 25, 1986, (UT), an overall brightening and antisunward jet was recorded continuously over several hours and is shown to be consistent with the increased activity recorded just prior to these observations. The outburst and resulting jet produced a large integrated intensity increase, and the rotation rate is estimated from the antisunward jet.

41650 (ESA-SP—278, pp vp) **Cometary MHD and chemistry: application to Halley.** Wegmann, R.; Schmidt, H.U.; Huebner, W.F.; Boice, D.C. (Southwest Research Inst., San Antonio, TX (USA)). Sep 1987. NTIS, PC A99/MF E03. (ETN—88-91972; CONF-8704138—).

From Conference on similarities and dissimilarities of comets; Brussels, Belgium (6 Apr 1987).

An MHD and chemical comet coma model was applied to the plasma flow, the magnetic field, and the ion abundances in Comet Halley. By alternating iterations between axisymmetric models with detailed chemistry and three dimensional models with rigorous account of the Lorentz forces, a consistent description of the plasma flow and chemical evolution in the ionized cometary coma is derived. Models appropriate to Comet Halley in which the magnetized plasma flow, the bow shock, the magnetic cavity of size 5000 km, and the model ion abundances at 1500 km and 6000 km from the nucleus are in qualitative agreement with the Giotto data were derived. The axisymmetric model correctly shows the three groupings of ions at each distance. The model abundances for the light ions, up to 21 amu, are in very good agreement with the 1500 km observations. The comparison becomes worse at higher molecular masses and greater distances from the nucleus.

41651 (ESA-SP—278, pp vp) **Anisotropic emission from comets: fans versus jets. 1: Concept and modeling.** Sekanina, Z. Sep 1987. NTIS, PC A99/MF E03. (ETN—88-91972; CONF-8704138—).

From Conference on similarities and dissimilarities of comets; Brussels, Belgium (6 Apr 1987).

Jets and fans of dust ejected from discrete emission sources on the sunlit side of comet nuclei were studied. Computer-generated images of these features illustrate the diversity of patterns that can be explained by varying the position of the spin axis, rotation period, location and extent of the active area, and the ejecta's dynamical constants for a given Sun-Earth-comet geometry. It is shown that an emission fan is generated by rotation of a high-latitude source about the spin axis of the nucleus with a relatively high obliquity, but that the fan's formation is rather insensitive to the rotation period. It appears that at least for comets with perihelia well outside the Earth's orbit, the position angle of a fan's observed axis virtually coincides with the projected direction of the spin axis, thus constraining the spatial orientation of the latter.

41652 (ESA-SP—278, pp vp) **Anisotropic emission from comets: Fans versus jets. 2: Periodic Comet Tempel 2.** Sekanina, Z. Sep 1987. NTIS, PC A99/MF E03. (ETN—88-91972; CONF-8704138—).

From Conference on similarities and dissimilarities of comets; Brussels, Belgium (6 Apr 1987).

The position of the rotation axis of P/Tempel 2 is constrained by projected orientations of the comet's sunward fan-like coma extension during 9 apparitions. The approach employed is based on the emission-cone concept formulated for a continuous (or quasi-continuous) collimated flow of dust ejected from discrete active regions on a rotating nucleus. The results show that the observations can be satisfied by assuming an invariable position of the pole, although this is not necessarily the only solution. The derived obliquity of 54 deg and the latitude of +60 deg for the southernmost boundary of the active source imply that the region experiences a polar day for 5 months about perihelion and a polar night for over 3 yr approximately centered on the aphelion point. Combining these results with scattered photometric and spectrophotometric information on the comet at large heliocentric distance, the outbursts observed near 3 AU are attributed to intermittent activity from the region shortly prior and following the polar night.

41653 (ESA-SP—278, pp vp) **Cometary evolution: clues from chondritic interplanetary dust particles.** Reitmeijer, F.J.M.; Mackinnon, I.D.R. Sep 1987. NTIS, PC A99/MF E03. (ETN—88-91972; CONF-8704138—).

From Conference on similarities and dissimilarities of comets; Brussels, Belgium (6 Apr 1987).

Cometary and interplanetary dust particles (IDP) are compared, and the mineralogical evolution of comet nuclei is discussed. Chondritic IDP have properties consistent with properties expected for cometary dust. The complex and varied mineralogy of these particles may indicate mineral alteration processes that occur in comet nuclei. Depending on the thermal budget of a comet, the upper few meters of nucleus material may maintain temperatures within regimes of hydrocryogenic (200 to 237 K) and low-temperature aqueous (274 to 400 K) alteration. Thus, layer silicates, carbonates, and sulfates may be important components of cometary dust and, correspondingly are common constituents of chondritic IDPs. Alteration of comet starting materials may be a common occurrence, and depends on the specific physical and chemical properties of each individual comet.

41654 (ESA-SP—278, pp vp) **Origin of low mass particles within and beyond the dust coma envelopes of Comet Halley.** Simpson, J.A.; Rabinowitz, D.; Tuzzolino, A.J.; Ksanfomality, L.V.; Sagdeev, R.Z. (Academy of Sciences, Moscow (USSR)). Sep 1987. NTIS, PC A99/MF E03. (ETN—88-91972; CONF-8704138—).

From Conference on similarities and dissimilarities of comets; Brussels, Belgium (6 Apr 1987).

Measurements from the Dust Counter and Mass Analyzer (DUCMA) instruments on VEGA-1 and -2 revealed unexpected fluxes of low mass (up to 10 to the minus 13th power g) dust particles at very great distances from the nucleus (300,000 to 600,000 km). These particles are detected in clusters (10 sec duration), preceded and followed by relatively long time intervals during which no dust is detected. This cluster phenomenon also occurs inside the envelope boundaries. Clusters of low mass particles are intermixed

with the overall dust distribution throughout the coma. The clusters account for many of the short-term small-scale intensity enhancements previously ascribed to microjets in the coma. The origin of these clusters appears to be emission from the nucleus of large conglomerates which disintegrate in the coma to yield clusters of discrete, small particles continuing outward to the distant coma.

41655 (ESA-SP—278, pp vp) **Particles injected by comets.** Singer, F.S. Sep 1987. NTIS, PC A99/MF E03. (ETN—88-91972; CONF-8704138—).

From Conference on similarities and dissimilarities of comets; Brussels, Belgium (6 Apr 1987).

Submicron sized particles released by comets into interplanetary (IP) space are discussed. Sensitive impact detectors on Explorer 46 satellite show large increases in flux during certain meteor streams. The total mass and lifetime of these particles were determined and their electric potential deduced. Space debris, which, in principle, could affect the observations, is showm to be unimportant. A more refined experiment on the Long Duration Exposure Facility (LDEF) to settle crucial problems ragarding IP particles is mentioned.

41656 (ESA-SP—278, pp vp) **Comparison of active regions on the nucleus of Comet Halley.** Reitsema, H.J.; Delamere, W.A.; Whipple, F.L. Sep 1987. NTIS, PC A99/MF E03. (ETN—88-91972; CONF-8704138—).

From Conference on similarities and dissimilarities of comets; Brussels, Belgium (6 Apr 1987).

The images of the nucleus of Comet Halley returned by the Giotto spacecraft reveal a number of active regions on the surface, one of which is near the expected location of the rotation axis. This feature is larger and brighter than other source regions, suggesting that the mechanism which drives this source is also different. At this active region near the rotation pole the Sun is circumpolar for a significant portion of the solar encounter. Continuous solar insolation causes heating of the nucleus to greater depths and results in the unique properties of this source region. For example, the dust scattering in the antisolar regions around the nucleus is less from the polar region than from the region at the sunward end of the nucleus, consistent with spotty ejection of dusty mantle from the sunward tip and widespread activity in the polar region.

41657 (ESA-SP—278, pp vp) **Comet rendezvous asteroid flyby mission.** Neugebauer, M. Sep 1987. NTIS, PC A99/MF E03. (ETN—88-91972; CONF-8704138—).

From Conference on similarities and dissimilarities of comets; Brussels, Belgium (6 Apr 1987).

The Comet Rendezvous Asteroid Flyby Mission (CRAF) is described. After gravity assists from Venus and Earth, the spacecraft will fly by the asteroid 46 Hestia en route to a rendezvous with P/Tempel 2 in Nov. 1996, when the comet is near aphelion. The scientific experiments for the CRAF mission are: an imaging system; a visual and infrared mapping spectrometer; an infrared radiometer; a penetrator carrying a gamma-ray spectrometer, a scanning differential calorimeter and evolved gas analyzer, accelerometers, and temperature probes; a neutral gas and thermal ion mass spectrometer; a secondary ion mass spectrometer for analyzing dust, gas, and thermal ions; a scanning electron microscope and particle analyzer; an X-ray fluorescence and gas chromatographic analyzer for collected dust and ice samples; a dust counter and velocity analyzer; a retarding potential ion mass spectrometer; a supra-thermal ion mass spectrometer and electron analyzer; a magnetometer; and a coordinated radio, electron, and plasma wave analyzer.

41658 (ESA-SP—278, pp vp) **Rosetta: a mission to sample the nucleus of a comet.** Wood, J.A. Sep 1987. NTIS, PC A99/MF E03. (ETN—88-91972; CONF-8704138—).

From Conference on similarities and dissimilarities of comets; Brussels, Belgium (6 Apr 1987).

The opportunities and problems of a spacecraft mission that would land on a comet nucleus, take samples, and return them in a suitably refrigerated state for study in terrestrial laboratories are discussed. These studies would greatly advance planetary science and astrophysics: the former by providing detailed information about pristine planetary material and planet-forming processes in the outer solar system; the latter by permitting the direct study of interstellar grains, individually and in great number. Laboratory techniques to handle and analyze fragile samples from the nucleus must be developed. Orbits of over 40 prospective target comets are listed. Spacecraft design and operation alternatives are summarized.

41659 (ESA-SP—278, pp vp) **Retrieving samples from comet nuclei.** Stuhlinger, E.; Bassner, H.; Fechtig, H.; Igenbergs, E.; Kuczera, H.; Loeb, H.; Schobert, D. (Technische Univ., Munich (West Germany)). Sep 1987. NTIS, PC A99/MF E03. (ETN—88-91972; CONF-8704138—).

From Conference on similarities and dissimilarities of comets; Brussels, Belgium (6 Apr 1987).

A comet nucleus sampling scenario is proposed. Material samples for analysis in earth-based laboratories should be collected continuously to a depth of 3 m below the surface, and at a solar distance of at least 2.5 AU where the comet surface is inactive. The spacecraft is propelled by chemical and electric thrusters. While hovering above the comet nucleus at an altitude of 500 to 1000 m, the spacecraft will dispatch a rotating drill on a tether. The drill pipe will be driven into the nucleus by a rocket-powered reaction wheel. The inner pipe of the drill, when filled with cometary material, will be withdrawn by the tether, stored on the spacecraft, and transported back to Earth.

41660 (ESA-SP—278, pp vp) **Role of hydrogen thermalization in shaping the Lyman-alpha coma.** Combi, M.R.; Smyth, W.H. (Conselho Nacional de Pesquisas, Rio de Janeiro (Brazil)). Sep 1987. NTIS, PC A99/MF E03. (ETN—88-91972; CONF-8704138—).

From Conference on similarities and dissimilarities of comets; Brussels, Belgium (6 Apr 1987).

Two interrelated aspects of the thermalization of cometary hydrogen were addressed using a three-dimensional Monte Carlo particle trajectory model: photochemical heating of the coma and the velocity distribution of cometary hydrogen leaving the inner coma that produces the extended Lyman-alpha coma. Observed cometary conditions were examined, ranging from productive comets like Kohoutek at very small heliocentric distances to intrinsically small comets like Giacobini-Zinner at 1 AU. The collisional decoupling of hydrogen yields bulk flow speeds and gas temperatures which are smaller than generally predicted in hydrodynamic models. By properly including these conditions the hydrogen velocity distribution required to produce the observed Lyman-alpha coma can be derived naturally. The two-dimensional morphology of the H coma is diagnostic of the physical conditions in the inner coma.

41661 (FRCEA-TH—47) **Acceleration and propagation of cosmic radiation. Production, oscillation and detection of neutrinos.** Lagage, P.-O. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France); Paris-7 Univ., 75 (France)). Jun 1987. 342p. (In French). NTIS (US Sales Only), PC A15/MF A01. Order Number DE88752428/JAW.

In recent years, the old problem of cosmic-ray acceleration and propagation has become alive again, with the discovery of the diffusive shock acceleration mechanism, and with the first measurements of the cosmic-ray antiproton flux, which appears to be higher than expected. I have shown that the new acceleration mechanism was slow and I have calculated the maximum energy that can be reached by particles accelerated in various astrophysical sites. I have also studied in detail a cosmic-ray propagation model which takes into account the antiproton measurements. Neutrino astronomy is a field much more recent and in rapid expansion, thanks to a convergence of interests between astrophysicists and elementary particle physicists. Several large neutrino detectors already exist; really huge ones are in project. I have studied the possible impact of the high energy (> 1 TeV) neutrino astronomy on models of cosmic-ray sources such as Cygnus X3. Comparing the low energy ({similar←to} 10 MeV) cosmic-ray antineutrinos with other sources of neutrinos and antineutrinos (sun, supernova, earth...), I have pointed out that the antineutrino background resulting from all the nuclear power-stations of the planet was sizeable. This background is a nuisance for some astrophysical applications but could be useful for studies on vacuum or matter neutrino oscillations (MSW effect).

I have also examined the MSW effect in another context: the travel through the earth of neutrinos from the supernova explosion SN1987a.

41662 **(FRNC-TH—3196) Radio-emission of pre-main sequence stars of the Rho Ophiuchi cloud: observations and interpretation.** Andre, P. (Paris-6 Univ., 75 (France)). Nov 1987. 257p. (In French). NTIS (US Sales Only), PC A12/MF A01. Order Number DE88754058/JAW.

Observations of the radio continuum emission of a young star population have been made at VLA on the whole molecular cloud Rho Ophiuchi, one of the closest site of star formation. A dozen of stellar sources have been detected. Radio emission of some identified objects seems to have a magnetic nature and be produced by gyrosynchrotron mechanism. In particular, one of the sources shows a radio radiation circularly polarized; two other stars have a radiation strongly variable probably due to magnetic eruptions more important than those detected in X radiation. More generally, radio observations select probably a specific population of young stars characterized by magnetic field presence extended on several stellar radii and by absence of dense circumstellar environment. Spatial distribution of these objects suggest, they are younger than most of the pre-main sequence stars.

41663 **(IC—88/51) Modular invariance and the two-loop vanishing of the cosmological constant.** Gava, E.; Iengo, R.; Sotkov, G. (Ecole Normale Superieure, 75 - Paris (France). Lab. de Physique Theorique; International School of Advanced Studies, Trieste (Italy)). (International Centre for Theoretical Physics, Trieste (Italy)). Mar 1988. 13p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703169/JAW.

With a moduli independent choice of super-Beltrami differentials, we show, by using the genus hyperelliptic formalism, that the requirement of modular invariance determines completely the two-loop amplitudes of the heterotic string theory for arbitrary external legs and that the cosmological constant is zero pointwise in moduli space. (author). 14 refs.

41664 **(INIS-mf—11229) Gravitation, black holes and space-time physics.** Ullmann, V. (Ceskoslovenska Akademie Ved, Ostrava. Ceskoslovenska Astronomicka Spolecnost). 1986. 273p. (In Czech). NTIS (US Sales Only), PC A12/MF A01. Order Number DE88703054/JAW.

A wide range of questions relating to the general theory of relativity, the physics of gravitation and space-time are discussed, including the relations between gravitation and the other fields of physics, mainly electromagnetism and the special theory of relativity, Einstein general relativity theory - the consequences of the principle of equivalence, the physics of curved space-time, equations of the gravitation fields, properties of gravitational energy and gravitational waves, the properties are analysed of certain significant solutions of Einstein field equations, causality and the global structure of space-time, horizons, the problem of space-time singularities, etc. The physics of black holes is discussed in detail as the extreme manifestation of gravitation also the problem of the structure and development of the universe with regard to present relativistic cosmology. Finally discussed is Mach principle, the quantizing of the field of gravitation and the problems of unified theories of the field. (V.U.).

41665 **(INIS-SU—32) Decametric radiation of quiet Sun.** Abranin, Eh.P.; Bazelyan, L.L. (AN Ukrainskoj SSR, Kharkov. Inst. Radiofiziki i Ehlektroniki). 1986. 32p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703283/JAW.

Preprint--304.

The results of investigations of two-dimensional angular distributions of quite Sun brightness at 25 MHz frequency are presented. The data of measurements of polar and equatorial angular dimensions, corona ellipticity and its full flux are given. It is reported on the discovery of decameter nonthermal component responsible for the quick (of the order of some minutes) angle distribution of Sun brightness. The algorithm for the counting of two-dimensional angular distribution of corona brightness approximated by the ellipsoid of rotation. Test for the choice of decametric inhomogeneity of corona model is suggested.

41666 **(INIS-SU—35) Decametric radio emission of Jupiter. 3. Some physical characteristics of S-component sources.** Ryabov, B.P. (AN Ukrainskoj SSR, Kharkov. Radioastronomicheskij Inst.). 1987. 48p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702812/JAW.

Preprint--2.

The results of recent observations of Jupiter at 10 to 23 MHz have been used to determine "active" (with respect to S-bursts) portions in the Northern and Southern trajectories of the Io's tube foot. As has been found, S-bursts are generated by a source inside Io's tube continuously as long as the tube foot remains within the active portions of the trajectory.

41667 **(ITF—87-46) Shock-wind mechanism of the origin of the shell-like structure in NGC 5128. Numerical modelling.** Gnatyk, B.I.; Krol', V.A. (AN Ukrainskoj SSR, Kiev. Inst. Teoreticheskoj Fiziki). 1987. 19p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703322/JAW.

It si shown that the shock-wind mechanism under acceptable values of its parameters can provide the necessary dynamics of the interstellar gas swept-up by a galactic wind from active nucleus in which a formation of the stellar shells is possible, for example, in NGC 5128. The periodic repeating process of star formation in a gas shell arisen due to the galactic wind interaction with interstellar medium and also the recurring activity of a nucleus lead to a formation of the star shell system observed in NGC 5128. Numerical calculations of the shell dynamics are made for various models of gas and star profiles in the chosen galaxy. 25 refs.; 4 figs.

41668 **(ITF—87-52) On the microstructure theory of a condensate layer in a white dwarf atmosphere.** Zubko, V.G. (AN Ukrainskoj SSR, Kiev. Inst. Teoreticheskoj Fiziki). 1987. 17p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703324/JAW.

The microstructure of a condensed carbon layer in the white dwarf is considered including the nucleation, growth and sedimentation of condensate particles. The stationary solutions of the kinetic equation are obtained for condensate particles. Model estimations show that particles may grow to 1-10 mcm and the condensate layer may be optically thick. 13 refs.; 3 figs.

41669 **(ITF—87-55) Spectral variability of Wolf-Rayet stars.** Marchenko, S.V. (AN Ukrainskoj SSR, Kiev. Inst. Teoreticheskoj Fiziki). 1987. 25p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703325/JAW.

The equivalent widths (W/sub λ/) of six Wolf-Rayet stars are given. In the stars HD 193077, HD 192641 W/sub λ/ variability is rare. The HD 192103 spectra show small-scale night-to-night W/sub λ/ variations. The HD 191765 is the most active one among the six WR stars. From the 1984 year data, the periodical changes of W/sub λ/ in three lines are detected: P1/sup α/.74 +- 0/sup α/.38. An interpretation of the eclipsing binary HD 193576 observations are proposed using the hypothesis about a common low-density gas envelope around the system. 40 refs.; 6 figs.; 6 tabs.

41670 **(LA-UR—88-1264) Planetary skin games.** Vaniman, D.T.; Reedy, R.C. (Los Alamos National Lab., NM (USA)). 1988. Contract W-7405-ENG-36. 6p. (CONF-880391—1). NTIS, PC A02/MF A01; GPO Dep. Order Number DE88009161/JAW.

From GEOTIMES: 19th lunar and planetary science conference; Houston, TX, USA (14 Mar 1988).

An informal review of techniques for analysis of meteorites and materials from the lunar surface is presented. Attention is given to problems associated with the production rates of cosmogenic nuclides.

41671 **(PB—88-194733/XAB) Solar-Geophysical Data Number 522, February 1988. Part 1 (prompt reports). Data for January 1988, December 1987, and late data.** Coffey, H.E.; McKinnon, J.A. (National Geophysical Data Center, Boulder, CO (USA)). Dec 1987. 105p. (SGD—522-PT-1). NTIS, PC A06/MF A01.

See also PB—88-179213, and PB—88-194741; Library of Congress catalog card No. 79-640375.

Contents include: Data for January 1988; IUWDS alert periods (Advance and Worldwide); Solar-activity indices; Solar flares; Solar radio emission; Stanford mean solar magnetic field.

41672 **(PB—88-194741/XAB) Solar-Geophysical Data Number 522, February 1988. Part 2 (comprehensive reports). Data for August 1987 and miscellanea.** Coffey, H.E.; McKinnon, J.A. (National Geophysical Data Center, Boulder, CO (USA)). Aug 1987. 56p. (SGD—522-PT-2). NTIS, PC A04/MF A01.

See also PB—88-179221, and PB—88-194733; Library of Congress catalog card No. 79-640375.

Contents include: Data for August 1987; Meudon Carte Synoptique; Solar flares, Solar radio bursts at fixed frequencies; Solar x ray radiation from GOES Staellite; Mass ejections from the sun; Active prominences and filaments.

41673 **(PB—88-205695/XAB) Radio and infrared observations of circumstellar envelopes: the progress since 1984.** Olofsson, H. (Chalmers Univ. of Tech., Goeteborg (Sweden). Onsala Space Observatory). 1984. 18p. (REPT—88/24). NTIS, PC E03/MF A01.

This review summarizes the observational achievements at radio and infrared wavelengths since 1984 concerning the circumstellar envelopes of evolved stars. The main emphasis is on the increased knowledge of late stellar evolution, in particular during the asymptotic giant branch phase and the transition to the planetary-nebula stage, and on the properties of gas/dust envelopes formed by stellar mass loss. It is not a critical review, and it is essentially free from historical references.

41674 **Formation and structure of galactic halos.** Hoffman, Y. (Los Alamos National Lab., NM (USA)). *Astrophysical Journal;* **328**: 489-498(May 1988).

The formation and structure of galaxies and clusters, which emerge from a primordial Guassian perturbation (delta) field via gravitational instability, are analytically studied. These bound objects are assumed to be seeded by local maxima of the delta-field. The density profile of these objects is found to depend on (1) the power spectrum of the delta-field, (2) the height of the peaks relative to the rms value of delta, and (3) the value of Omega(0). In particular, it is found that in the cold dark matter case, flat or slightly increasing rotation curves are expected for all acceptable values of Omega(0) and H(0). 21 references.

41675 **Agb star evolution.** Becker, S.A. (Los Alamos National Lab., NM (USA)). pp 18 of 194th National Meeting of the American Chemical Society, Division of Nuclear Chemistry and Technology. Washington, DC; American Chemical Society (1987). (CONF-8708244—).

From American Chemical Society Division of Nuclear Chemistry and Technology meeting; New Orleans, LA, USA (30 Aug 1987).

The evolution of giant stars is discussed. Particular attention is given to the evolution of stars on the asymptotic giant branch.

41676 **Cosmology and particle physics.** Turner, M.S. (NASA/Fermilab Astrophysics Center, Fermi National Accelerator Lab., Batavia, IL 60510 (US)). pp 100-214 of Intersection between elementary particle physics and cosmology. Piran, T.; Weinberg, S. Teaneck, NJ; World Scientific Pub. Co. (1986). (CONF-8312150—).

From Jerusalem winter school for theoretical physics; Jerusalem, Israel (28 Dec 1983).

Progress in cosmology has become linked to progress in elementary particle physics. In these six lectures, the author illustrates the two-way nature of the interplay between these fields by focusing on a few selected topics. In the next section the author reviews the standard cosmology, especially concentrating on primordial nucleosynthesis and discusses how the standard cosmology has been used to place constraints on the properties of various particles. Grand Unification makes two striking predictions: (i) B non-conservation; (ii) the existence of stable, superheavy magnetic monopoles. Both have had great cosmological impact. In the following section the author discusses baryogenesis, the very attractive scenario in which the B,C,CP violating interactions in GUTs provide a dynamical explanation for the predominance of matter over antimatter and the present baryon-to-photon ratio. Monopoles are a cosmological disaster and an astrophysicist's delight. In Section 4 discusses monopoles, cosmology, and astrophysics. In the fourth lecture the author discusses how a very early (t≦10/sup -34/ sec) phase transition associated with spontaneous symmetry breaking (SSB) has the potential to explain a handful of very fundamental cosmological facts, facts which can be accommodated by the standard cosmology, but which are not "explained" by it. The fifth lecture is devoted to a discussion of structure formation in the universe.

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REFER ALSO TO CITATION(S) 41671

41677 **(AD-A—189052/4/XAB) Dynamics of small- and large-scale irregularities at sub-auroral latitudes. Final report, 1 May 1985-31 August 1987.** Aarons, J.; Mendillo, M. (Boston Univ., MA (USA). Dept. of Astronomy). 10 Oct 1987. 21p. NTIS, PC A03/MF A01.

In order to study the dynamics of ionospheric F-layer irregularities at latitudes below the auroral oval, radio, optical, and incoherent-scatter observations were initiated primarily in the region of 75°W longitude. In addition, earlier observations including in-situ satellite measurements were used. The principal conclusions were: (1) the sub-auroral ionospheric observations could be understood by correlating F-layer irregularities with ring-current intensities as measured by Dst, the magnetic field measurement made near the magnetic equator; and sub-auroral irregularities that affect HF communications and over-the-horizon observations last over several nights while the ring current recovers from an injection of ions during a magnetic storm; and (2) local observations of Stable Auroral Red (SAR) Arcs and by Millstone Hill incoherent scatter data reveal that the weaker SAR Arcs detected are important in determining the physics of the generation of these emissions.

41678 **(AD-A—190920/9/XAB) Simultaneous density and electric-field fluctuation spectra associated with velocity shears in the auroral oval.** Basu, S.; Basu, S.; MacKenzie, E.; Fougere, P.F.; Coley, W.R. (Air Force Geophysics Lab., Hanscom AFB, MA (USA)). 1 Jan 1988. 25p. (AFGL-TR—88-0024). NTIS, PC A03/MF A01.

Pub. in Jnl. of Geophysical Research, Vol. 93, No. A1, 115-136(1 Jan 1988). Original contains color plates: All DTIC and NTIS reproductions will be in black and white.

Simultaneous satellite in-situ measurements of density (Delta N/N) and electric-field fluctuation (Delta E) spectra in the high-latitude ionosphere are presented using two orbits of Dynamics Explorer 2 (DE 2) data traversing, respectively, the F region at 350-km altitude and the topside ionosphere at 900-km altitude. The spectral study was primarily confined to large structured-velocity regions in the auroral oval. By means of the very complete set of energetic particle, dc and ac electric field, field-aligned current, thermal plasma density, and temperature measurements available from DE 2, the authors were able to identify two categories of spectra associated with velocity shears irrespective of the height of the satellite. The first category was observed in very intense velocity-shear regions of shear frequencies - 10 Hz in conjunction with large field-aligned current densities. The second category was observed in more moderate velocity shear regions of shear frequencies about 1 Hz in conjunction with weak field-aligned currents.The observations of Delta N/N Delta E spectral behavior are compared to recent work on two-dimensional plasma turbulence theory and nonlinear simulations of the collisional Kelvin-Helmholtz (KH) instability. In particular, the spectral behavior associated with the moderate velocity shear category agrees well with some recent computations of the spatial power spectra of the KH instability.

41679 (AD-A—190947/2/XAB) Studies of ionosphere/magnetosphere dynamics using SABRE and HILAT. Final report, 1 March 1986-28 February 1987. Jones, T.B.; Waldock, J.A. (Leicester Univ. (UK). Dept. of Physics). 20 Sep 1987. 29p. NTIS, PC A03/MF A01.

Plasma drift measured by SABRE in the E-region are compared with those obtained from HILAT, at an altitude of 800 km. Results are not consistent with perfect mapping of the electric field between the two regions. Furthermore, no field-aligned current signature is observed by SABRE. A comparison of E-region plasma drifts measured by SABRE and F-region scintillations measured by the NNSS satellites suggests that the latter may be related to regions of reduced electric field in the F-region. This is consistent with the presence of field-aligned currents that produce kilometer-scale structure in the F-region plasma. Mean plasma-convection patterns in the E-region are derived as a function of the IMF components By and Bz and the magnetic index Kp. Convection flows are much stronger for southward Bz. The time of the evening convection reversal occurs at later local times for increasingly negative By. As Kp increases, radar measurements occur during a higher proportion of the day and the evening convection reversal also moves to earlier local times.

41680 (AD-A—191159/3/XAB) WAVFLD: a program to compute ionospheric-height gain functions and field strengths at VLF. Interim report, October 1986-September 1987. Ferguson, J.A.; Hitney, L.R. (Naval Ocean Systems Center, San Diego, CA (USA)). Nov 1987. 74p. (NOSC/TD—1192). NTIS, PC A04/MF A01.

Implementation of a full-wave fields program developed for calculations at ELF is described. The program incorporates modifications to the original code for use at VLF, including allowance for multiple modes. Other changes relate to improving compatibility of the basic program setup with that of other programs in the Defense Nuclear Agency repertoire.

41681 (AD-A—191164/3/XAB) Coordinated ground and space measurements of auroral surge over South Pole. Technical report. Rosenberg, T.J.; Detrick, D.L.; Mizera, P.F.; Gorney, D.J.; Berkey, F.T. (Aerospace Corp., El Segundo, CA (USA). Space Sciences Lab.). 1 Feb 1988. 42p. (TR—0086A(2940-06)-5). NTIS, PC A03/MF A01.

Coincident ground-based and satellite observations are presented of a premidnight auroral surge over Amundsen-Scott South Pole station. The set of near-simultaneous measurements provides an excellent opportunity to gain a more-quantitative understanding of the nature of premidnight substorm activity at high geomagnetic latitudes. The surge produced a rapid onset of cosmic radio noise absorption at the station. On the polar-orbiting DMSP-F6 spacecraft, intense x-ray emissions with E > 2-keV energy were imaged 1 to 2 deg magnetically equatorward of the South Pole approximately 1 min prior to the peak of the absorption event. The precipitating electron spectrum determined from the x-ray measurements could be characterized by an e-folding energy of approx. 11 keV and is found to be adequate to account for the cosmic noise absorption and maximum auroral luminosity recorded at South Pole. Photometer, all-sky camera, riometer, and magnetometer data are used to estimate the velocity of motion and spatial extent of the auroral precipitation and the ionospheric currents associated with the surge.

41682 (AD-A—191201/3/XAB) Ionospheric convection signatures and magnetic-field topology. Coley, W.R.; Heelis, R.A.; Hanson, W.B.; Reiff, P.H.; Sharber, J.R. (Southwest Research Inst., San Antonio, TX (USA)). 1 Nov 1987. 14p. NTIS, PC A03/MF A01.

Pub. in Jnl. of Geophysical Research, Vol. 92, No. A11, 12352-12364(1 Nov 1987). Original contains color plates: All DTIC and NTIS reproductions will be in black and white.

A statistical study is presented of signatures of the high-latitude ionospheric convection pattern and the simultaneously observed energetic electron precipitation. Most often convection cells are found in which the sunward flowing-region contains auroral particle precipitation but the antisunward flowing region does not. However, observations also show the frequent occurrence of convection cells in which neither the antisunward nor the sunward flowing plasma region contains auroral particle precipitation. These findings may appear within the dawnside or duskside convection pattern and strongly suggest that such convection cells may be associated with open magnetic-field lines that thread the magnetotail lobes. Examination of the interplanetary magnetic field (IMF) data shows that this lobe cell convection signature is most likely to be accompanied by the signature of dayside merging when the IMF has a significant y component but is directed southward. A lobe convection cell has a location and sense of circulation that are dependent on the sign of By. For the northern hemisphere, clockwise circulation displaced to the duskside appears roughly 35% of the time when By is positive, and anticlockwise circulation displaced to the dawnside appears when By is negative. The same circulation sense and location exist in the southern hemisphere for the opposite polarity of By. At times of northward IMF, the circulation within the polar cap can be at least partially on closed field lines and cannot be easily reconciled with merely a distortion of the standard two-cell convection pattern. The significance of these results to several models of the solar wind/magnetosphere interaction is discussed.

41683 (AD-A—191210/4/XAB) Plasma-wave instrument on the AMPTE/IRM (active magnetospheric particle-tracing explorers/ion release module) spacecraft. Report for 1 October 1986-30 September 1987. Gurnett, D.A. (Iowa Univ., Iowa City (USA). Dept. of Physics and Astronomy). 30 Sep 1987. 5p. NTIS, PC A02/MF A01.

Papers submitted to refereed journals include: Simulation and Nonlinear Stage of Electrostatic Waves Observed During the AMPTE Lithium Release in the Solar-Wind; Electron Number Density from the AMPTE/IRM Plasma-Wave Experiment During Solar Wind Lithium Releases; A Comparison of the Plasma Wave Spectra From 100 Hz to 100 khz for the Eight AMPTE Chemical Releases; High-Frequency Electrostatic Waves at Earth's Bow Shock; and Nature and the Nonlinear Evolution of Electrostatic Waves Associated with the AMPTE Solar-Wind Releases. Papers Published in Refereed Journals include: Electron Plasma Waves in the Solar WInd; AMPTE/IRM and UKS Observations; An Analysis of the Shocklike Electrostatic Noise Observed During AMPTE Solar-Wind Ion Releases; Electron Cyclotron Harmonic Waves Observed by the AMPTE/IRM Plasma Wave Experiment Following a Lithium Release in the Solar Wind; AMPTE/IRM Observations of Waves Associated with Flux-Transfer Events in the Magnetosphere; Observation of Nonlinear-Wave Decay Processes in the Solar Wind by the AMPTE/IRM Plasma Wave Experiment; and Observations and Theory of the AMPTE Magnetotail Barium Releases.

41684 (AD-A—191216/1/XAB) Plasma-wave instrument on the AMPTE/IRM (active magnetospheric particle-tracing explorers/ion release module) spacecraft. Final report for 1 December 1981-31 August 1987. Anderson, R.R.; Gurnett, D.A. (Iowa Univ., Iowa City (USA). Dept. of Physics and Astronomy). 27 Jan 1988. 5p. NTIS, PC A02/MF A01.

Original contains color plates: All DTIC and NTIS reproductions will be in black and white.

The primary purposes of the Active Magnetospheric Particle Tracing Explorers (AMPTE) program were (1) to carry out the release and monitoring of lithium and barium ions in the solar wind and the distant magnetosphere in order to study the transport of energization of magnetospheric particles, and to investigate the instabilities and wave-particle interactions associated with the releases and subsequent evolution of the injected clouds, and (2) to carry out large releases of barium in the solar wind with the objective of producing artificial comets and studying the interaction of the injected plasma clouds with the solar wind.

41685 (AD-A—191341/7/XAB) New low-altitude dose measurements. Gussenhoven, M.S.; Filz, R.C.; Brautigam, D.H.; Hanser, F.A.; Mullen, E.G. (Air Force Geophysics Lab., Hanscom AFB, MA (USA)). Jun 1987. 9p. (AFGL-TR—88-0019). NTIS, PC A02/MF A01.

Pub. in IEEE Transactions on Nuclear Science, Vol. NS-34, No. 3, 676-683(Jun 1987).

The Defense Meteorological Satellite Program (DMSP) F7 satellite carries a dosimeter that measures radiation dose behind four hemispherical aluminum domes of different thicknesses and

distinguishes low (electron) and high (proton) thresholds of energy deposition. The dosimeter also returns accurate, high-time-resolution dose measurements. Short-term measurements of dose from three sources, inner radiation-belt protons, outer radiation-belt electrons and solar flares, are presented. Empirical models of dose rate are constructed for the 840-km altitude of the DMSP orbit and compared to predictions of the NASA models. The NASA model values for proton dose in the South Atlantic Anomaly (SAA) are approximately 50% higher than the DMSP average values. The NASA outer-zone electron model prediction values are too high by an average factor of 6, and are not reliable for short-term predictions. Included in the analysis are two of the largest solar-proton events the first was relatively short-lived and produced a hard energy spectrum. The second event was much softer but gave a total dose behind .55 gm/sq.cm. of aluminum shielding in excess of 25 rad(Si) for the first three days of the event.

41686 **(AD-A—191409/2/XAB) Observation of nonlinear-wave decay processes in the solar wind by the AMPTE IRM plasma-wave experiment. Technical report.** Koons, H.C.; Roeder, J.L.; Bauer, O.H.; Haerendel, G.; Treumann, R. (Aerospace Corp., El Segundo, CA (USA). Space Sciences Lab.). 5 Feb 1988. 30p. (TR—0086(6940-06)-14). NTIS, PC A03/MF A01.

Original contains color plates: All DTIC and NTIS reproductions will be in black and white.

Nonlinear-wave decay processes were detected in the solar wind by the plasma-wave experiment aboard the AMPTE-IRM spacecraft. The main process is generation of ultra-low-frequency ion-acoustic waves from the decay of Langmuir waves near the electron plasma frequency. Frequently this is accomplished by an enhancement of emissions near twice the plasma frequency. This enhancement is most likely due to the generation of electromagnetic waves from the coalescence of two Langmuir waves. These processes occur within the electron foreshock in front of the earth's bow shock.

41687 **(AD-A—191655/0/XAB) MUF (maximum usable frequency) (3000) as an indicator for F-region variations. Final report, February 1986-August 1987.** Paul, A.K. (Naval Ocean Systems Center, San Diego, CA (USA)). Jan 1988. 105p. (NOSC/TR—1204). NTIS, PC A06/MF A01.

Ionograms recorded at Brighton, Colorado during the last sunspot maximum are still being studied. Samples show that the high quality and high temporal resolution of the data may yield new information about the dynamics of the ionosphere, especially in the F region. F-region parameters from these data show that this part of the ionosphere is highly variable, with short periods of the order of the order of fractions of an hour. This report explains why the maximum usable frequency (MUF) (3000) appears to be the most-appropriate indicator for F-region variations.

41688 **(AD-A—191767/3/XAB) Empirical modeling of nighttime easterly and westerly vlf propagation in the earth-ionosphere waveguide. Professional paper for period ending June 1987.** Pappert, R.A.; Hitney, L.R. (Naval Ocean Systems Center, San Diego, CA (USA)). Dec 1987. 2p. NTIS, PC A02/MF A01.

It has been known for many years that easterly and westerly propagation of VLF in the earth-ionosphere waveguide is nonreciprocal with the mean attenuation rate to the west being greater than to the east for ground to ground transmissions. It is also true that nightime propagation to the west is more difficult to predict than is propagation to the east. For example, a simple exponential beta=0.5 per km, h'=87km (notation of Wait and Spies) profile does an excellent job of predicting nocturnal in-flight measurements over the Hawaii-San Diego path but does not predict nighttime propagation over the Hawaii-Wake path. This is partly due to the fact that propagation to the west is less stable than propagation to the east. In this study, full wave solutions are used to show that propagation to the west is more sensitive to upper levels of the ionosphere than is propagation to the east. It therefore seems reasonable that propagation to the west senses more variable regions of the ionosphere than does propagation to the east and that this, at least in part, is responsible for the difficulty of predicting westerly propagation. Comparisons are made between calculations based on empirical electron-density profiles and in-flight measurements between Hawaii and San Diego, and Hawaii and Wake.

41689 **(AD-A—191857/2/XAB) Molecular sources of ionospheric holes. Final report, 1 April 1984-30 September 1987.** Guberman, S.L. (Smithsonian Astrophysical Observatory, Cambridge, MA (USA)). 19 Nov 1987. 50p. NTIS, PC A03/MF A01.

The dissociative recombination of molecular ions with electrons determines many of the properties of the Earth's ionosphere under both quiescent and disturbed conditions. However, in spite of its importance, there has never been an experimental measurement of dissociative recombination rates from individual excited-ion vibrational levels. Completed are large scale ab initio calculations of cross sections and rates for the dissociative recombination of the molecular oxygen ion leading to excited oxygen atoms in the lS and lD states, the upper states of the well-known green and red lines, respectively. A new method for calculating electronic autoionization widths using high-Rydberg-state wave functions to represent the inner part of the free-electron wave function has been used and tested on the NO molecule where the widths can be calculated to an expected accuracy of about 15%. THe widths have been used to determine dissociative recombination cross sections as a function of electron energy. Large windows have been discovered in the cross sections from excited vibrational levels. The windows, at which the cross sections drop precipitously, are due to the overlap of the peak in the continuum vibrational wave functions.

41690 **(AD-A—191894/5/XAB) Data needed to verify/quantify models.** Paul, A.K. (Naval Ocean Systems Center, San Diego, CA (USA)). Aug 1986. 11p. NTIS, PC A03/MF A01.

Advanced digital ionosondes have mainly two advantages compared with the classical with the classical analog systems: they are able to record the full information content of an echo reflected from the ionosphere with high precision in digital form and in many instances those data can be processed on a computer with little or no interaction by an operator. An echo is characterized by its frequency, travel time, or virtual height, amplitude and phase relative to the phase of the transmitted pulse. The frequency is related to the plasma frequency or electron density at the reflection point, the virtual heights are needed for the computation of electron-density profiles, while the amplitude is mainly determined by the absorption coefficient along the path of the signal. The most complex information is contained in the phase, the polarization of an echo can be obtained from the change of the phase with antenna orientation, the change of the phase with antenna orientation, the change of phase with frequency permits improved precision of the virtual heights, the change of phase with time is the doppler frequency and the variation of the phase with distance of over a plane yields the angle of arrival. The automatization makes the processing more economic permitting, for instance, much higher temporal resolution than the standard one ionogram per hour sequence.

41691 **(AD-A—191901/8/XAB) High-resolution h-f time-of-arrival measurements (1981-1985).** Rose, R.B. (Naval Ocean Systems Center, San Diego, CA (USA)). May 1987. 10p. NTIS, PC A02/MF A01.

Between 1981 and 1985, absolute time-of-arrival (TOA) measurements were made on h-f skywave time-standard signals at different frequencies. 113 path-months of TOA data were collected over a one hop path between Ft. Collins, CO, and San Diego, CA. In addition, 15 path-months of data were collected between Ft. Collins and Oahu, HI, and 12 path-months were gathered on signals between Tokyo, Japan and Oahu. The data show a higher degree of ionospheric movement than was expected. It also shows a higher degree of stratification within layers than can normally be explained with simple, single-layer ionospheric assumption.

41692 **(AD-A—191903/4/XAB) LUF (lowest usable frequency) model uncertainty assessment. Professional paper.** Sailors, D.B.; Moision, W.K. (Naval Ocean Systems Center, San Diego, CA (USA)). Jan 1987. 20p. NTIS, PC A03/MF A01.

A statistical analysis of observed oblique sounder lowest observed frequency (LOF) and predicted lowest usable frequency (LUF) was to assess the accuracy of the PROPHET algorithm QLOF version 2.0. A LOF data base of 1814 LOFs from 29 paths was established for the assessment. The data was screened into subsets to determine the effect of particular paths, universal and local time, sounder type, path length and orientation, season, month, sunspot number, and mid-path latitude. Version 2.0 had a bias of 0.55 MHz low, an rms error of 1.95 MHz, and a correlation coefficient with the observed data of 0.89. The rms error increases with increasing range. A higher residual was noted for the months of July through October. An increase in residual at midlatitude was noted. Reasons for these errors are given. A modification to the absorption index term which determines the latitudinal and seasonal variation is suggested.

41693 **(AD-A—191913/3/XAB) Comparison with oblique sounder data of high-latitude h-f propagation predictions from Radar C and Ambscom computer programs. Professional paper for May 1987.** Dave, N. (Naval Ocean Systems Center, San Diego, CA (USA)). Nov 1987. 11p. NTIS, PC A03/MF A01.

Availability: Document Partially Illegiable.

A study was done using two HF propagation prediction programs - Radar C and AMBCOM - to determine how well they predict median values of oblique sounder data of maximum observed frequencies (MOF) at high latitudes. The main differences between RADAR C and AMBCOM are the inclusion in the latter of high-latitude ionosphere and auroral absorption models, as well as a more-sophisticated and accurate ray-tracing scheme. The data for the Winnipeg-Resolute Bay corresponds to high sunspot number, while the others correspond to low sunspot number. Hence, this study provides information on the performance of the two programs for various high-latitude paths at both high and low sunspot number. AMBCOM was found to give generally better agreement with the above data than did RADAR C. Comparison of details of model predictions from the two computer programs for the above data-base is used to form an understanding of this improvement in prediction capability.

41694 **(AD-A—191943/0/XAB) Spacecraft requirements for predictions of geomagnetic activity (a tutorial). Technical report.** Vampola, A.L. (Aerospace Corp., El Segundo, CA (USA). Space Sciences Lab.). 1 Mar 1988. 21p. (TR—0086A(2940-05)-9). NTIS, PC A03/MF A01.

Operational and research spacecraft require predictions of geomagnetic activity due to various effects of the geomagnetic activity on their operation. At high altitude, electrical charging of spacecraft surfaces, which occurs as a result of hot plasma injected from the geomagnetic tail during substorms, can produce discharges that result in spurious operation of the spacecraft. A reliable prediction of such activity can permit additional vigilance on the part of ground controllers at times of possible spurious operation of the spacecraft. Large magnetic disturbances, which accelerate electrons to high energies in the magnetosphere, increase backgrounds in sensors such as star sensors used for attitude control and also can produce spurious operation through the mechanism of thick dielectric charging which also produces discharge pulses. Again, reliable prediction of such magnetic storms, which requires a knowledge of solar-wind conditions, would be of great value in operational management of space assets. For low-altitude spacecraft which are subject to orbit perturbations as a result of changes in atmospheric scale height, constituent density, and temperature, operational procedures can also benefit from a predictive capability of geomagnetic activity which is closely linked to modifications of the atmospheric density profile.

41695 **(AD-A—191944/8/XAB) Outer-zone electron precipitation produced by a vlf transmitter. Technical report.** Vampola, A.L.; Adams, C.D. (Aerospace Corp., El Segundo, CA (USA). Space Sciences Lab.). 1 Mar 1988. 39p. (TR—0086A(2940-05)-2). NTIS, PC A03/MF A01.

Using high-resolution pitch-angle measurements made by a magnetic-focusing electron spectrometer on the S3-3 satellite while in the drift-loss-cone region of the magnetosphere, characteristics of fluxes of 108 to 654-keV electrons precipitated in the inner zone, in the slot region, and in the outer zone of the magnetosphere are all shown to be consistent with the precipitation having been produced by the same ground-based VLF transmitter, UMS. Pitch angle measurements are used to locate the longitude of precipitation. The temporal pattern of transmitter operation obtained from synoptic data from a ground-based VLF receiver is used along with drift-rate calculations to predict the electron energies as a function of L-shell which should be observable by the S3-3 instrument. The predicted energy response is then compared with the in-situ observations, getting complete agreement. Finally, wave-particle resonance calculations are made for each of the three regions. The study indicates that ground-based VLF transmitters, which have previously been shown to produce precipitation in the inner zone and slot regions, are almost certainly instrumental in precipitating electrons in the outer zone also.

41696 **(AD-A—191954/7/XAB) Hf MUF (maximum usable frequencies) model uncertainty assessment. Professional paper.** Roy, T.N.; Sailors, D.B. (Naval Ocean Systems Center, San Diego, CA (USA)). Jan 1987. 2p. NTIS, PC A02/MF A01.

To assess the accuracy of MUF model prediction, a statistical analysis of observed oblique sounder median maximum observed frequencies (MOF) and predicted maximum usable frequencies (MUF) was conducted. A data base consisting of 13,054 hours of oblique sounder MOFs measured on 70 paths were compared against the predicted MUF values from MINIMUF-3.5, MINIMUF 85 and an unrelated MUF model, the HF Broadcast WARC Model (HFBC 84). The data were screened into subsets to determine the effect of particular paths, path length and orientation, season, month, latitude, sunspot number, diurnal trends, geographic region and sounder type. The accuracy of all three models was very close, with the MINIMUF-3.5 model having the lowest rms error of 4.44 MHz. MINIMUF 85 was next with an rms error of 4.58 MHz and HFBC 84 was last with an error of 4.67 MHz. Correlation was good for all three models. Coefficients were .824, .819 and .827 for MINIMUF-3.5, MINIMUF 85 and HFBC 84, respectively. The primary difference between MINIMUF-3.5 and MINIMUF 85 appeared when detailed analysis of the accuracies was conducted. When the variation in error was noted as a function of season, sunspot number, or range, for instance, there was less variation in the accuracy of MINIMUF 85.

41697 **(AD-A—192140/2/XAB) Radio-wave scintillations and ionospheric irregularities at high latitudes. Final report, 1 April 1986-31 March 1987.** Kersley, L.; Pryse, S.E.; Wheadon, N.S. (University Coll. of Wales, Aberystwyth (UK). Dept. of Physics). 30 May 1987. 46p. NTIS, PC A03/MF A01.

Results are presented of studies of ionospheric scintillation obtained by monitoring of transmissions from NNSS satellites at Kiruna, Northern Sweden during a two-year period from September 1984 to September 1987. Attention is concentrated in this report on phase-scintillation morphology. Also presented are results of model studies of the geometrical influences in amplitude and phase scintillations at a high-latitude site aimed at interpreting the observations and understanding the nature of the ionospheric irregularities responsible for the scintillations. Also discussed are results of two coordinated studies of ionospheric irregularities using scintillation observations and data from Hf and VHF backscatter radar systems, respectively.

41698 **(AD-A—192154/3/XAB) Deep dielectric charging effects due to high-energy electrons in Earth's outer magnetosphere.** Baker, D.N.; Belian, R.D.; Higbie, P.R.; Klebesadel, R.W.; Blake, J.B. (Aerospace Corp., El Segundo, CA (USA). Space Sciences Lab.). 5 Feb 1988. 33p. (TR—0086A(2940-05)-1). NTIS, PC A03/MF A01.

Many spacecraft operational problems in Earth's outer magnetosphere appear to be due to intense, transient radiation phenomena. Three types of naturally occurring, and highly variable, hostile-particle radiation environments are encountered at, or near, the geostationary orbit: (1) high-energy protons due to solar flares; (2) energetic ions and electrons produced by magnetospheric substorms; and (3) very-high-energy electrons of uncertain origin. In

this report, particular emphasis is given to highly relativistic electrons, (approximately 10 MeV). Electron fluxes and energy spectra are shown that were measured by two high-energy electron sensor systems at 6.6 earth radii from 1979 through 1984. Large, persistent increases in this population were found to be relatively infrequent and sporadic in 1979-81 around solar maximum. During the approach to solar minimum (1981 - present), it is observed that the highly relativistic electrons occur with a regular 27-day periodicity and are well associated with the re-established solar-wind-stream structures. Through a superposed epoch analysis technique, it is shown that an energetic-electron enhancement typically rises on a 2- to 3-day time scale and decays on a 3- to 4-day time scale at essentially all energies above approximately 3 MeV. The analysis suggests that these electrons have a very deleterious influence on spacecraft systems due to deep dielectric charging and low-dose susceptibility effects.

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REFER ALSO TO CITATION(S) 40646, 40684, 40853, 41689, 42116, 42357

41699 **(AD-A—190924/1/XAB) Contributions of autoionizing resonances to the electron collisional excitation rates for Be-like ions.** Chen, M.H.; Crasemann, B. (Ministere des Armees, Saint-Cloud (France). Direction Techniques des Armements Terrestres). 22 Sep 1987. 28p. NTIS, PC A03/MF A01.

The contributions of autoionizing resonances to the electron-impact excitation-rate coefficients for the n = 2 to n = 2 transitions in Be-like ions were evaluated for six ions with atomic numbers Z = 30, 34, 36, 42, 47, and 54. The calculations were carried out in the isolated-resonance approximation. Interference between direct and resonance channels was neglected. The detailed Auger and radiative rates were computed using the multiconfiguration Dirac-Fock model. Results for 45 transitions among 10 states from 1s2 2l 2l configurations are listed. For electric-dipole-allowed transitions, the contributions from the autoionizing resonance are quite small. However, the autoionizing resonances can enhance the excitation rates by a factor of 2-4 dipole forbidden transitions.

41700 **(AD-A—191119/7/XAB) New approach to generating negative-ion beams. Final report, 1 July 1986-30 September 1987.** Neynaber, R.H.; Tang, S.Y. (California Univ., San Diego (USA)). 2 Nov 1987. 4p. NTIS, PC A02/MF A01.

This report describes measurements of ion-pair production cross sections for He*(2(1,3)S)-Li, Li-Cs, Li-Na, and Li-Na*(3p) collisions at energies of several keV. Measurements of chemi-ionization cross sections for He*(2(1,3)S)-Li collisions are also mentioned. A method is described for exciting a fraction of the atoms in a Li vapor to the 2p resonance state using a dye laser. The fraction is determined by observing with the laser on and off the ion-pair production of Cl- when a fast Cl beam collides with the vapor.

41701 **(AD-A—191393/8/XAB) Comparison of various alkali gas-cell atomic-frequency standards. Technical report.** Camparo, J.C.; Frueholz, R.P. (Aerospace Corp., El Segundo, CA (USA). Chemistry and Physics Lab.). 12 Feb 1988. 21p. (TR—0086(6945-05)-5). NTIS, PC A03/MF A01.

The present calculations indicate that a Rubidium gas cell standard shows the greatest potential for frequency stability, and in this regard nature has been uncommonly propitious. One should not, however, interpret this result as a superiority of the Rb87 standard in all regards. For example, if it is of primary importance to construct a miniature gas-cell standard, then cesium might prove to be more advantageous given the fact that its minimum-volume cavity occupies less than half the volume of a corresponding Rb87 cavity. Additionally, magnetic field sensitivities are less for Cs133 as a consequence of its greater hyperfine transition frequency. The only statement one should make regarding the present results is that, of all the possible alkali gas-cell standards that could be considered, a Rb87 standard appears to yield the best attainable short-noise-limited performance.

41702 **(AD-A—191816/8/XAB) E Matrix' for the Loewdin alpha function, expanded in a Taylor series: an analytic treatment of molecular charge density near the origin.** Jones, H.W.; Bussery, B.; Weatherford, C.A. (Florida State Univ., Tallahassee (USA). Dept. of Physics). 1987. 8p. NTIS, PC A02/MF A01.

Pub. in International Jnl. of Quantum Chemistry: Quantum Symposium 21, 693-698(1987).

A displaced STO can be expanded in spherical harmonics with the coefficient function or Loewdin or functions characterized by a C matrix. These or functions themselves may be expanded in a Taylor series that is characterized by its own E Matrix. This expansion is necessary for the representation of the or' function by a power series and for its evaluation about the origin. As an application, the power series for the molecular charge density in the vicinity of the center of a model diatomic molecule. The analytic approach is general and yields excellent results.

41703 **(AD-A—191820/0/XAB) Analytic method for three-center nuclear attraction integrals: a generalization of the Gegenbauer addition theorem.** Weatherford, C.A. (Florida State Univ., Tallahassee (USA). Dept. of Physics). 1988. 8p. NTIS, PC A02/MF A01.

Pub. in International Jnl. of Quantum Chemistry, Vol. 33, 19-26(1988).

A completely analytic method for evaluating three-center nuclear-attraction integrals for STOS is presented. The method exploits a separation of the STO into an evenly loaded solid harmonic and a OS STO. The harmonics are translated to the molecular center of mass in closed finite terms. The OS STO is translated using the Gegenbauer addition theorem; ls STOS are translated using a single parametric differentiation of the OS formula. Explicit formulas for the integrals are presented for arbitrarily located atoms. A numerical example is given to illustrate the method.

41704 **(AD-A—192066/9/XAB) Electron-ejection cross sections in electron- and ion impact ionization: ab initio and semiempirical calculations.** Manson, S.T.; Miller, J.H. (Georgia State Univ., Atlanta (USA). Dept. of Physics). 1987. 11p. NTIS, PC A03/MF A01.

Pub. in International Jnl. of Quantum Chemistry: Quantum Chemistry Symposium 21, 297-306(1987).

Ab initio calculations of single and double differential cross sections for ionization by fast, charged particles within the framework of the Born approximation are presented. In addition, a semiempirical method based on the asymptotic Bethe-Born expansion is also discussed. Both are applied to ionization of helium by electrons and protons in an effort to assess their accuracy and validity. Agreement with experiment is quite good. The implications for other targets is discussed.

41705 **(AD-A—192099/0/XAB) Effect of collisions on forbidden lines.** Coutts, J.; Peck, S.K.; Stoner, R.; Cooper, R. (Joint Inst. for Lab. Astrophysics, Boulder, CO (USA)). 1 Nov 1987. 9p. NTIS, PC A02/MF A01.

Pub. in Jnl. of Applied Physics, Vol. 62, No. 9, 3514-3521(1 Nov 1987).

Results are presented for experiments probing the effect of collisions on forbidden lines. Two contrasting lines are investigated – a spin-forbidden dipolar transition and a spin-allowed electric quadrupole transition. The results are explained in terms of straightforward physical models.

41706 **(AD-A—192147/7/XAB) Final technical report on Contract N00014-81-K-0759 (Oregon University, Eugene). Report for 1 July 1981-30 September 1987.** Girardeau, M.D. (Oregon Univ., Eugene (USA)). Jan 1988. 25p. (QFT—16). NTIS, PC A03/MF A01.

A new second-quantization representation was derived for low-energy positron-hydrogen scattering. A new mechanism is proposed for atomic recombination in plasmas, whereby the binding energy is carried away by a plasmon. It is suggested that this mechanism may compete with radiative and three-body modes in the case of recombination to sufficiently highly-excited and perturbed states of hydrogen. A procedure for calculation of the transition

rate is outlined in a model which treats the plasma oscillations by the Bohm-Pines canonical transformation and the atomic bound states by a second canonical transformation.

41707 **(ATOMKI-B—24(1987)) High-energy ion-atom collisions. Comments on the Workshop on high-energy ion-atom collisions held in Debrecen, Hungary, 3-5 Aug 1987.** Berenyi, Denes. (Magyar Tudomanyos Akademia, Debrecen. Atommag Kutato Intezete). 1987. 13p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703100/JAW.

Submitted to Comments At. Mol. Phys. (UK).

The progress in energetic ion-atom collision studies is shown briefly on the basis of the Workshop in the field above held in Debrecen. The 'hot topics', namely 'two-center' and electron correlation phenomena, collisions with antiprotons, recent results on alignment and orientation in energetic heavy-ion collisions, autoionization electron studies in the meV region and the utilization of heavy-ion storage rings in ion-atom collision experiments are treated. (author) 4 figs.

41708 **(CEA-CONF—9288) Use of a discharge in an hollow cathode as neutral atom source for resonant ionization mass spectrometry.** Berthoud, T.; Briand, A.; Khelifa, N.; Mauchien, P. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Inst. de Recherche Technologique et de Developpement Industriel (IRDI)). 1987. 4p. (In French). (CONF-8707107—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88753911/JAW.

From 1. international conference on laser M 2 P; Lyon, France (7 Jul 1987).

The resonance ionization mass spectrometry in our laboratory is aimed at simplification of isotope measurements of elements present in mixtures and at measurement of very small isotopes. An atomization source which produces an atomic beam collimated from a discharge in a hollow cathode has been developed. First results of this spectrometry with an uranium atomic jet are presented.

41709 **(CEA-CONF—9291) Dipolar transition probabilities of CeI in the R6G range.** Villate, D. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Dept. de Physico-Chimie). 1987. 5p. (CONF-8707169—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88753599/JAW.

From 19. European group of atomic spectroscopy; Dublin, Ireland (14 Jul 1987).

41710 **(CNIC—00050) SM-1 negative ion source.** Huang Zhenjun; Wang Jianzhen. (China Nuclear Information Centre, Beijing, BJ). 1987. 8p. (In Chinese). (SMC—0003). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702632/JAW.

The working principle and characteristics of SM-1 Negative Ion Source is mainly introduced. In the instrument, there is a device to remove O/sub 3/. This instrument can keep high density of negative ions which is generated by the electrical coronas setting out electricity at negative high voltage and can remove the O/sub 3/ component which is harmful to the human body. The density of negative ions is higher than 2.5 x 10/sup 6/ p./cm/sup 3/ while that of O/sub 3/ components is less than 1 ppb at the distance of 50 cm from the panel of the instrument. The instrument sprays negative ions automatically without the help of electric fan, so it works noiselessly. It is widely used in national defence, industry, agriculture, forestry, stock raising, sidelines and in the places with an equipment of low density of negative ion or high concentration of O/sub 3/ components. Besides, the instrument may also be used to treat diseases, to prevent against rot, to arrest bacteria, to purify air and so on.

41711 **(CONF-870715—9) Electron-impact ionization of heavy atomic ions.** Pindzola, M.S.; Griffin, D.C.; Bottcher, C. (Auburn Univ., AL (USA). Dept. of Physics; Rollins Coll., Winter Park, FL (USA). Dept. of Physics; Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 8p. NTIS, PC A02/MF A01;1; GPO Dep. Order Number DE88008371/JAW.

From 15. international conference on the physics of electronic and atomic collisions; Brighton, UK (22 Jul 1987).

General theoretical methods for the calculation of direct and indirect processes in the electron-impact ionization of heavy atomic ions are reviewed. Cross section results for Xe^{0+} and U^{89+} are presented. 12 refs., 4 figs.

41712 **(CTA-IEAV-NT—006/82) Behavior of the Variational celular method with respect to the variation of some input parameters - Application to the LiH molecule.** Rosato, A.; Sakane, K.K. (Centro Tecnico Aeroespacial, Sao Jose dos Campos (Brazil). Inst. de Estudos Avancados). 1982. 29p. (In Portuguese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703118/JAW.

The behavior of the variational celular method with respect to the variation of some input parameters is analysed. The molecules LiH and HF are taken as example in all cases.

41713 **(DOE/ER/13262—T2) Excitation of atoms and molecules in collisions with fast, highly charged ions: Progress report, January 1, 1987-February 29, 1988.** Watson, R.L. (Texas A and M Univ., College Station (USA). Cyclotron Inst.). 1 Mar 1988. Contract FG05-84ER13262. 20p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88007795/JAW.

This paper briefly describes the following projects: Molecular fragmentation in heavy ion collisions; Correlations of recoil ion charge and energy; Resonant electron transfer to double K-vacancy states in oxygen compounds; and Quenching of metastable states in fast Mg projectiles. 7 refs., 6 figs., 3 tabs.

41714 **(DOE/ER/13456—12) The production and destruction of negative ions: Progress report, September 1, 1987-SEPTEMBER 15, 1988.** Pegg, D.J. (Tennessee Univ., Knoxville (USA). Dept. of Physics). 1988. Contract FG05-85ER13456. 21p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88007996/JAW.

During the present grant period we have concentrated our efforts on investigating the structure of negative ions using the technique of fast-beam photoelectron detachment spectroscopy. A newly constructed crossed laser-ion beams apparatus permits us to study photon-negative ion collisions. The highlight of the work has been our photodetachment measurements on Ca/sup {-}/. We were able to determine, for the first time, that this ion is stable, being formed in the $(4s^24p)^2P$ state. The electron affinity of Ca ($4s^2\ ^1S$) was measured to be 43 +- 7 MeV. This result is particularly satisfying since it represents the culmination of early measurements on Ca/sup {-}/, including autodetachment studies, which date back to the first proposal and progress reports submitted to DOE in 1984. We have also obtained photoelectron spectra from beams of He/sup {-}/ and B/sup {-}/ ions. We have just started a program to measure the angular distribution of photoelectrons detached in photon-negative ion collisions. Preliminary results for the case of the photodetachment of He/sup {-}/ ions at a photon energy of 590 nm are encouraging. 7 refs., 10 figs.

41715 **(DOE/ER/13655—3) High resolution spectroscopy of dissociating molecules: Final report, December 15, 1986-October 14, 1987.** Janda, K.C. (Pittsburgh Univ., PA (USA). Dept. of Chemistry). 15 Mar 1988. Contract FG02-87ER13655. 5p. NTIS, PC A02/MF A01. Order Number DE88007959/JAW.

The goal of this project has been to study the structure and dynamics of rare gas-halogen van der Waals molecules. These molecules are important because they provide the only chemical dynamics problem for which precise state-to-state dynamics can be determined by both experiment and full, three-dimensional quantum mechanics theory.

41716 **(DOE/ER/45333—T1) Mixed-valent and heavy fermions and related systems: Technical progress report, October 1, 1987-September 14, 1988.** Schlottmann, P. (Temple Univ., Philadelphia, PA (USA). Dept. of Physics). 9 May 1988. Contract FG02-87ER45333. 10p. NTIS, PC A02/MF A01;1; GPO Dep. Order Number DE88010581/JAW.

This paper discusses Ce-impurities in LaB_6 and $LaAl_2$, critical behavior of ferromagnetic Heisenberg chains; integrable SU(2)—invariant model; soluble narrow-band model with possible relevance to heavy-fermions and resonating valence bonds, soluble variant of the two-impurity Anderson model; De Haas-van Alphen effect in the Anderson lattice for large orbital degeneracy; interactions mediated by spin-fluctuations in He^3; mixed-valence and heavy-fermion systems and high-temperature superconductivity. (LSP)

41717 **(GSI—88-20(prepr.)) Nonlinear interactions and poly-positronium bound states.** Ionescu, D.C.; Reinhardt, J.; Mueller, B.; Greiner, W.; Soff, G. (Frankfurt Univ. (Germany, F.R.). Inst. fuer Theoretische Physik). (Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (Germany, F.R.); Frankfurt Univ. (Germany, F.R.). Inst. fuer Theoretische Physik). Mar 1988. 18p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88754156/JAW.

The creation of a hypothetical many electron-positron bound system was suggested as a possible source of the correlated peaks observed in the e/sup +/ and e/sup -/ spectra of various heavy-ion collisions. A new electron-electron interaction was assumed which becomes large in high-Z nuclear collisions. We investigate energy states of such (e/sup +/e/sup -/)/sup n/ clusters, bound by scalar and vector Fermi-type interactions. For the bi-positronium system (e/sup +/e/sup -/)/sup 2/ we derive a single-particle equation employing the Hartree-Fock method. The required values of the coupling constants are found to be inconsistent with precision QED experiments.

41718 **(IAE—4487/1) Precise calculation of coulomb binding energy of mesic molecules.** Kutukova, E.B.; Frolov, A.M.; Eremin, A.Yu. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1987. 5p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88703142/JAW.

Results of precise calculations of the Coulomb binding energies of mesic molecules are presented. It is shown that the absolute error of level determination does not exceed 1x10/sup -6/ eV (the relative one does not exceed 1x10/sup -11/). It is quite sufficient for all practical purposes, which solves completely the problem of mesic molecule Coulomb state determination. 7 refs.; 3 tabs.

41719 **(INFN-LNF—88-07(PT)) Multichannel generalization of multiple scattering theory. Application to the analysis of inner shell X-ray spectra of mixed-valent compounds.** Natoli, C.R.; Benfatto, M. (Istituto Nazionale di Fisica Nucleare, Rome (Italy)). 1988. 20p. (CONF-8710334—). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702865/JAW.

From Core level spectroscopy in condensed systems; Osaka, Japan (19 Oct 1987).

We outline a many-body description of the photoemission and photoabsorption processes that incorporates the multichannel treatment of the atomic dynamical excitations into the framework of the multiple scattering theory. In this way the interplay between excitation dynamics and electronic and geometrical structure of the ground state is elucidated. At the same time this approach provides a theoretical model for the study of the evolution from the adiabetic to the sudden regime. We derive a new multiple scattering expansion that takes into account interchannel transitions as well. As an application we discuss the homogeneous and inhomogeneous mixed-valent compounds, where the theory provides a clue at resolution of the "threshold puzzle" and sheds light onto the relation between photoemission and photoabsorption spectroscopy.

41720 **(IPNO-DRE—87-13) Spectroscopic properties of tetravalent actinide ions in solids.** Krupa, J.C. (Paris-11 Univ., 91 - Orsay (France). Inst. de Physique Nucleaire). 1987. 61p. NTIS (US Sales Only), PC A04/MF A01. Order Number DE88752446/JAW.

Optical spectroscopy is a powerful tool to study the electronic structure of an optically active transition ion in the condensed phase media and consequently to study the interactions between the central ion and its environment. The main interactions that are essential for an understanding of the energy level distribution of an f/sup N/ ion in solids is briefly examined and the deduced free-ion and crystal field parameters for Pa/sup 4+/, U/sup 4+/, Np/sup 4+/ are compared to those of the isoelectronic configuration lanthanide ions. At last, the actinide series offers an interesting situation since the 5f electrons in the metals are delocalized in the light actinides and then localized, that sould affect the nature of the chemical bonding in the two parts of the series. Is this trend reflected in the An/sup 4+/ spectroscopic parameters.

41721 (JINR—R-7-86-322, pp 51) **Angular distribution of the K-ll/sub 2,3/ll/sub 2,3/ satellite Auger transitions in the Ne-Ne/sup 3+/ (5,5 MeV/nucleon) ion-atom collisions.** Ricz, S.; Kadar, V.A.; Varga, D. 1986. (In Russian). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88780065/JAW.

In Heavy ion physics - 1985. Collection of annotations of the Nuclear Reaction Laboratory of the Joint Nuclear Research Institute works, 1985.

41722 (JINR—R-7-86-322, pp 50) **Multiple ionization of Ne in the Ne/sup 3+/, Ne/sup 10+/, Ar/sup 6+/ (5,5 MeV/nucleon) - Ne ion-atom collisions.** Kadar, I.; Shchegolev, V.A.; Varga, D. 1986. (In Russian). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88780065/JAW.

In Heavy ion physics - 1985. Collection of annotations of the Nuclear Reaction Laboratory of the Joint Nuclear Research Institute works, 1985.

41723 **(JINR-R—2-87-151) On properties of πK-dimesoatom.** Efimov, G.V.; Ivanov, M.A.; Lyubovitskij, V.E. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics; Tomskij Gosudarstvennyj Univ. (USSR)). (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1987. 10p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88703383/JAW.

Submitted to the journal JETP Lett. .

The properties of πK-dimesoatom are discussed. In the framework of the virtonquark model the principal properties of the πK-dimensoatom are calculated: the lifetime, binding energy, the zero wave function, lamb shift. 18 refs.; 2 figs.; 2 tabs.

41724 **(JINR-R—4-87-616) Effects of electromagnetic structure of nuclei in mesic molecules.** Bakalov, D.D. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1987. 18p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703407/JAW.

Submitted to the journal Sov. J. Nucl. Phys. .

The corrections to the binding-energy of ddμ and dtμ measic molecules owing to the electromagnetic structure of the nuclei have been calculated. It is shown that these effects give the essential contribution to the nonrelativistic shift and hyperfine splitting of ddμ and dtμ molecule energy levels, and it should be taken into account in the calculations of the resonant formation rates. The contribution of electromagnetic structure of nuclei to the relativistic shift is negligibly small. 19 refs.; 4 figs.

41725 **(JINR-R—5-87-211) Generalised KS-transformation: from 5-dimensional hydrogen atom to 8-dimensional isotrope oscillator.** Davtyan, L.S.; Mardoyan, L.G.; Pogosyan, G.S.; Ter-Antonyan, V.M.; Sisakyan, A.N. (Erevanskij Gosudarstvennyj Univ. (USSR)). (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1987. 8p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88703408/JAW.

Submitted to the journal J. Phys., A.

It is shown that non-bijective quadric transformation generated by the Kelly matrix changes the problem of a 5-dimensional hydrogen atom into the problem of an 8-dimensional oscillator. 6 refs.

41726 **(MLM—3522(OP)) Effect of impurities on ions in tritium.** McConville, G.T. (Monsanto Research Corp., Miamisburg, OH (USA). Mound). 1988. Contract AC04-76DP00053. 7p. (CONF-880505—35). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88012877/JAW.

From 3. topical meeting on tritium technology in fission, fusion and isotopic applications; Toronto, Canada (1 May 1988).

Tritium has a steady-state ion concentration of about one part in 10^9 of the background molecules. It will be shown that the recombination with electrons limits the ion density and the recombination is faster if the ion is in an excited vibrational state. These ions determine the reaction rates with other gases. When impurities of the order of 1 ppM are present, it will be shown that the ion resides on the impurity. Impurities are shown to affect the temperature dependence of the $D_2 + T_2$ reaction. The decrease in reaction rate with increasing temperature above 220 K is consistent with the increasing vapor pressure of an impurity, but the level must be below 10 ppM. Unfortunately, such an impurity may be below the level of our present detectability. How this situation may come about in the DT reaction will be discussed. 17 refs., 3 figs., 4 tabs.

41727 **(RI—199) Experimental determination of Doppler shift for hydrogen lines of H/sub 2//sup +/-ion beams in the energy range 150-2000 keV.** Pobedonostsev, L.A.; Kramarovskij, Ya.M.; Seleznev, B.K.; Berezin, A.B.; Ostrovskij, Yu.I.; Parshin, P.F. (Radievyj Inst., Leningrad (USSR); AN SSSR, Leningrad. Fiziko-Tekhnicheskij Inst.; Akademiya Grazhdanskoj Aviatsii, Leningrad (USSR)). (Radievyj Inst., Leningrad (USSR)). 1986. 18p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703474/JAW.

Experimental works on direct verification of relativistic formula for Doppler effect are critically reviewed. An improved technique for measurements and processing of the results is described. A systematic discrepancy between experimental and theoretical data is noticed. Possible causes of discrepancies are considered. 6 refs.; 6 figs.

41728 **(UCRL—98470) Nonlinear materials for frequency conversion.** Velsko, S.P.; Eimerl, D. (Lawrence Livermore National Lab., CA (USA)). 22 Mar 1988. Contract W-7405-ENG-48. 13p. (CONF-880110—28). NTIS, PC A03/MF A01. Order Number DE88008343/JAW.

From SPIE O-E Lase '88: optoelectronics and laser applications in science and engineering; Los Angeles, CA, USA (10 Jan 1988).

Two figures of merit, the threshold power (P/sub th/) and the limiting volume (V/sub min/) can be used to compare the relative efficiency and economy of new harmonic generating crystals. The properties of barium metaborate and L-Arginine phosphate are used to illustrate the effect of nonlinearity, birefringence, and damage threshold on these figures of merit.

41729 **(UNB-FIS—17/87) Dielectric screenning, exciton binding energy and the insulator-metal transition in molecular hydrogen.** Ferraz, A.; Oliveira, F.A.; Amato, M.A. (Brasilia Univ. (Brazil). Dept. de Fisica). Sep 1987. 9p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88701713/JAW.

Using an appropriate model for dielectric screening in molecular hydrogen we calculate the static dielectric constant ϵ (o) in the proximity of the insulator-metal transition. The dielectric constant ϵ (o) is constructed in terms of the energy gap, the exciton binding energy and the plasmon frequency. Considering the energy gap from the band-structure calculation of Friedli and Ashcroft and making an estimate of the lower exciton binding energy in the instability region, ϵ (o) is shown to diverge at a critical density given by r /sub s//sup */= 1,57 a.u.

41730 **$3p^63d^8$—$3p^53d^9$ transitions in iron-like ions from Ru^{10+} to Gd^{30+}.** Ekberg, J.O.; Feldman, U.; Reader, J. (E.O. Hulburt Center for Space Research, Naval Research Laboratory, Washington, DC 20375-5000). *Journal of the Optical Society of America B: Optical Physics;* **5**: No. 6, 1275-1284(Jun 1988).

Spectra of 14 Fe-like ions from Ru^{10+} to Gd^{30+} were observed with laser-produced plasmas and grazing-incidence spectrographs. The wavelengths range from 26 to 78 A. Line identifications were made for transitions of the $3p^63d^8$—$3p^53d^9$ array. The number of identifications varied from 42 in Ru^{10+} to 10 in Gd^{30+}. Experimental values for many of the energy levels of the $3p^63d^8$ and $3p^53d^9$ configurations were derived from the measured wavelengths. Predicted values for missing levels and for ions not observed in the isoelectronic sequence were obtained from parametric fits of the differences between the observed level values and relativistically calculated level values. Results are given for all ions of the sequence from Ru^{10+} to Yb^{44+}. Wavelengths for magnetic dipole transitions within the $3p^63d^8$ configuration calculated from the energy levels are given for several ions.

41731 **Two-photon (VUV and visible) resonant ionization spectroscopy of atoms and molecules.** McCann, M.P.; Chen, C.H.; Payne, M.G. (Oak Ridge National Lab., Chemical Physics Section, P.O. Box X, Oak Ridge, TN 37831-6378 (US)). pp 166 of XV international conference on quantum electronics (Digest of technical papers). Washington, DC; Optical Society of America (1987). (CONF-870488—).

From 15. international conference on quantum electronics; Baltimore, MD, USA (27 Apr 1987).

Technical Paper THGG 43.

The laser is responsible for the discovery and investigation of many nonlinear spectroscopic processes. Of increasing interest among these is two-photon resonant absorption. Two-photon absorption allows the examination of atomic and molecular states that lie in a higher-energy region than is normally accessible by a one-photon process. This is due to parity considerations. Two-photon resonant spectroscopy tends to be less sensitive to fluctuations in the laser light source and, therefore, yields more easily reproduced data than nonresonant multiphoton spectroscopy. With commercially available narrow bandwidth pulsed lasers, the energy levels of many gaseous atoms and molecules can be measured as accurately with the longest VUV monochromators. The results obtained with broad bandwidth lasers are shown in Table I and agree well with measurements by other researchers. Two-photon rates were also obtained in this experiment. Two-photon rates are, therefore, useful parameters for predicting the signal size in future experiments.

41732 **Macroscopic quantum jumps in a single atom.** Schenzie, A.; Brewer, R.G. San Jose, CA; International Business Machines Corporation (1987). vp.

A single atom optical clock proposed over ten years ago utilizes an amplification scheme which only recently was recognized as a problem in quantum statistics. The atom, a three state system, has two coupled transitions that are driven continuously by two external fields, one being an allowed transition and the other a forbidden transition. It was argued that the weak transition, which is difficult to detect, could be monitored by the presence or absence of spontaneous emission of the strong transition. Thus, when the atom is shelved in the metastable state, the strong transition is extinguished, but when the atom executes a single quantum jump, it triggers a succession of perhaps a million quantum jumps in the strong transition, an amplification that can be detected easily. This intuitive argument for alternating bright and dark intervals assumes, however, that the atom is always in an eigenstate. Should the atom be in a superposition state, because of coherent excitation, it could be imaged that the weak transition would merely reduce the intensity of the strong transition slightly. This issue is resolved by calculating the photon counting statistics, the probability W(n,T) of observing precisely n photon counting events in a collection T in a quantum mechanically consistent way. The results cannot be described by classical statistics. A compact analytic form was obtained for W(n,T). This presentation is represented by viewgraphs and abstracts only.

41733 **Laser cooling of neon metastable states.** Shimizu, F.; Shimizu, K.; Takuma, H. Tokyo, Japan; University of Electro-Communications (1987). vp.

The first demonstration of the layer cooling of a neutral atomic beam other than alkali atoms is reported. A neon beam was cooled using the 640 nm transition between the metastable state 1s5 (J=2) and 2pg (J=3). These cooled 1s5 metastable atoms were transferred to another metastable state 1s3 (J=0). The population in 2pg can decay only to the metastable state 1s5. Therefore, these

metastable atoms can be cooled by the same technique used for the cooling of alkali beams. The experimental setup is basically the same as the sodium cooling by Phillips. The metastable atoms are created by a dc discharge, and are extracted through a pinhole on the anode. The deceleration laser with 640 nm is sent from the opposite direction towards the Ne beam source. It is usually circularly polarized. To transfer the cooled 1s5 atoms to the 1s3 level, a 586 nm laser is crossed perpendicular to the Ne beam approximately 1 cm upstream of the Doppler analysis point. The results show that a large fraction of the 1s5 atoms can be slowed 100 m/s suitable for the further deceleration and trapping by standing wave lasers or by magnetic fields. Neon atoms in the beam are expected in either 1s5, 1s3, or ground states. It is also possible to produce pure 1s3 or ground state atoms from 1s5 atoms by various laser pumping schemes. Therefore, by combining the cooling technique, cooled atoms in single metastable or ground state can be produced. This presentation is represented by viewgraphs only.

41734 **An intense beam system with no applied magnetic field.** Zhang, X.; Yao, R.L.; Striffler, C.D. (Univ. of Maryland, College Park, MD (US)). pp 97 of The 1987 IEEE international conference on plasma science (Abstracts). Piscataway, NJ; IEEE Service Center (1987). (CONF-870651—).

From IEEE international conference on plasma science; Crystal City, VA, USA (1 Jun 1987).

During the past year, electron beam propagation over distances of many centimeters with no applied magnetic field has been experimentally demonstrated. The radial confining force is provided by ions that are created in a gas cloud that is located immediately downstream of the entrance end of a long drift tube. A steady-state model has been formulated to describe the propagation of an intense relativistic electron beam into vacuum after passage through a localized plasma. The system has no applied magnetic field and the electron and ion species downstream of the localized plasma source have finite temperature. The self-consistent downstream equilibrium can be derived by assuming that the particle distribution for each species is a relativistic Maxwellian in the frame traveling with the fluid velocity of that component. These distributions in the laboratory frame lead to the Bennett radial density profile with a mean axial velocity. The authors note that, unlike previous derivations of the Bennett pinch equilibrium from particle distribution functions, our derivation assumes neither that the axial velocity of the particles is much greater than the transverse velocities nor that the axial velocity is the same for all particles of a given component. The particle distribution functions are, therefore, exact solutions of the relativistic Vlasov equation. In addition to radial force balance, conservation of energy and continuity of current are applied in order to relate the downstream properties with the diode and the localized plasma source properties.

41735 **Intense beam propagation and collective ion acceleration in a localized plasma source-vacuum system.** Yao, R.L.; Striffler, C.D.; Guillory, J. (Univ. of Maryland, College Park, MD (US)). pp 97-98 of The 1987 IEEE international conference on plasma science (Abstracts). Piscataway, NJ; IEEE Service Center (1987). (CONF-870651—).

From IEEE international conference on plasma science; Crystal City, VA, USA (1 Jun 1987).

The properties of intense relativistic electron beams in vacuum in the presence of a large applied magnetic field has been examined for many years. At the University of Maryland, such beam shave been studied when a localized source of ions is placed immediately downstream of the entrance end of a vacuum drift tube into which the beam is injected and the beam current exceeds the space-charge limiting current. In this regime, collective ion acceleration to energies many times the beam energy is observed as well as an increase in the net beam energy propagated. With respect to net beam propagation, the authors present a model for the downstream beam equilibria consisting of beam electrons and comoving ions. Assuming a large applied magnetic field, they equate the downstream beam properties with the diode and localized plasma source properties via conservation of energy and continuity of current. The authors are thus able to calculate self-consistent steady-state system parameters and to determine conditions for maximum propagated energy. These properties are compared to the results from a particle simulation described below.

41736 **Electron dynamics in an e-beam ring diode.** Ambrosiano, J.; Terry, R. (Berkeley Research Associates, Springfield, VA (US)). pp 98 of The 1987 IEEE international conference on plasma science (Abstracts). Piscataway, NJ; IEEE Service Center (1987). (CONF-870651—).

From IEEE international conference on plasma science; Crystal City, VA, USA (1 Jun 1987).

Modular e-beam ring diodes like the Large-Area Bremsstrahlung source (LAB) used on Maxwell Laboratory's Blackjack facility offer distinct advantages over other designs. When inductances are properly tuned, these sources are very reliable and can be arranged concentrically to illuminate a large area. Several important aspects of these sources need to be addressed before they can be made optimally compact; e.g. the effect of cathode tip geometry and gap closure on e-beam dynamics and diode impedance. Basic trends are also needed for incorporation into multiple-ring circuit models. In this study the authors employ the 2D electromagnetic particle-in-cell code ELECTRA whose equilibrium formulation allows fast calculation of the steady state e-beam configuration. Results of a number of simulations are presented showing the effects of geometry and gap closure on the performance of the diode.

41737 **Theory of resonant mesomolecule formation.** Leon, M. (Los Alamos National Lab., Los Alamos, NM (US)). pp 8 of Contributions to the muon catalyzed fusion workshop. Idaho Falls, ID; Idaho National Engineering Lab. (1985). (CONF-840660—).

From Workshop on muon-catalyzed fusion reactions; Jackson, WY, USA (7 Jun 1984).

The calculation of resonant mesomulecule formation has been extended to include the effects of hyperfine splitting, initial molecular angular momentum K/sub i/ > O, and incoming orbital angular momentum L > O. The authors discuss the resulting molecular formation rates for singlet and triplet tμ-atoms colliding with D/sub 2/, DT, and DH molecules. For the canonical value of the energy of the loosely-bound dtμ-state, they predict that the singlet-D/sub 2/ molecular formation rate is large down to quite low target temperatures, while the other rates vanish for T ≦ 200 K. For reasons to be discussed, the authors refer to the singlet-D/sub 2/ molecular formation as "anomalous" and the others as "normal". The recent LAMPF experiment implies just such a large low-temperature singlet-D/sub 2/ rate, and a vanishing T < 200 K singlet-DT rate as well. Thus so far the theory seems to be basically correct, but there are some problems as well.

6404 Fluid Physics

REFER ALSO TO CITATION(S) 40698, 42131

41738 **(AD-A—191039/7/XAB) Magnetohydrodynamic liquid-metal flows and power losses in a rectangular channel with a moving conducting wall. Revision. Research and development report.** Brown, S.H.; Reilly, P.J.; Sondergaard, N.A. (David W. Taylor Research and Development Center, Bethesda, MD (USA)). 15 Jul 1987. 18p. (DTNSRDC—87/040-REV). NTIS, PC A03/MF A01.

Pub. in Jnl. of Applied Physics, Vol. 62, No. 2, 386-396(15 Jul 1987) Supersedes AD-A185 890.

Fully developed, viscous liquid-metal flows and power losses in a rectangular channel in a uniform, external magnetic field were studied for moderate Hartmann numbers and different channel aspect ratios. The channel was assumed to have insulating side walls parallel to the field, a perfectly conducting moving top wall, and a stationary bottom wall perpendicular to the field. Exact-series solutions and numerical calculations are presented for velocity profiles, induced magnetic-field distributions, current densities, voltage profiles, and viscous and joulean power losses. The joulean and viscous dissipation are computed from squared quantities involving infinite series with double summations for finite M. The diverging series derived for the viscous power losses is made convergent by slightly modifying the velocity profile of the conducting fluid at the moving interface. The effect of the applied field is to produce an eddy current that accelerates the bulk fluid to velocities greater than those without the field, but because of the presence of the side walls, the velocities are less than in one-dimensional couette flow.

Except at small aspect ratios and Hartmann number, almost the entire power loss resulted from the component of the induced current parallel to the applied field.

41739 **(AD-A—192043/8/XAB) Unified study of plasma-surface interactions for space power and propulsion. Final report, 1 May 1983-31 August 1984.** (R and D Associates, Alexandria, VA (USA)). Apr 1986. 39p. (RDA-TR—126600-001). NTIS, PC A03/MF A01.

Interactions between plasmas, whose parameters are typical of high-specific-power, high-specific-impulse devices, and various conducting and insulating surfaces were studied. The study was carried out using metallic and dielectric surfaces arranged perpendicular (facing upstream and downstream) and parallel, and under the parameter constraints of particular devices. This study was carried out under conditions that allow better diagnostic examination of the plasma-surface region with the ability to vary plasma parameters, flow relative to the samples, electrical conduction to the (metal) samples, etc. The aim was to delineate the basic physics of plasma-surface interaction under conditions applicable to the design of space-power and propulsion systems. The arcjet was installed and tested; the downstream plasma flow was examined, and its parameters (temperature, composition, density, flow velocity, etc.) were correlated with the variation in the discharge energy and other parameter of the thruster.

41740 **(AD-A—192192/3/XAB) Emission-based feedback system for stabilizing an inductively coupled plasma. Technical report.** Marks, M.A.; Hieftje, G.M. (Indiana Univ., Bloomington (USA). Dept. of Chemistry). 4 Apr 1988. 7p. (INDU/DC/GMH/TR—88-26). NTIS, PC A02/MF A01.

Pub. in Applied Spectroscopy, Vol. 42, No. 2, 277-280(1988).

An emission-controlled feedback system was investigated for stabilizing an ICP. Unlike previous stabilization methods that monitor only the power being sent to the plasma, the present one uses an emission signal from either argon or an internal reference element as a stability indicator. Using a previously constructed power-modulation circuit for rf power control, the feedback network adjusts the plasma power to compensate for changes in the emission level of the reference element. It is shown to be particularly useful for reducing or eliminating the drift that occurs when the plasma is warming up. A key point for successful operation of the feedback arrangement is that both the feedback signal and the analysis photometric systems must receive light from exactly the same region of the plasma. Also, the excitation energy and ionization characteristics of the reference element should be comparable to those of the desired analyte. Results with several combinations of argon, barium, calcium, iron, manganese, sodium, and strontium lines are presented.

41741 **(DOE/ER/25020—T1) The asymptotic degrees of freedom of fluid flows: Annual progress report for July 1, 1987-June 30, 1988.** Foias, C. (Indiana Univ., Bloomington (USA). Dept. of Mathematics). Apr 1988. Contract FG02-86ER25020. 9p. NTIS, PC A02;3. Order Number DE88010706/JAW.

We have improved the estimates of the dimension of an inertial manifold for the Kuramoto-Sivashinsky equation, for the Kolmogorov-Spiegel-Sivashinsky equation, and for the Ginzburg-Landau equation. We have shown that the ring laser cavity equations have a finite dimensional attractor. We have constructed several approximative inertial manifolds for a large class of equations, including the 2D Navier-Stokes equations, which yield new approximative ordinary differential equations with better error estimates than those of the usual Galerkin approximation. We have numerical evidence confirming these theoretical results. 18 refs.

41742 **(IC—87/384) Unsteady hydromagnetic free-convection flow with radiative heat transfer in a rotating fluid - I: Incompressible optically thin fluid.** Bestman, A.R.; Adjepong, S.K. (International Centre for Theoretical Physics, Trieste (Italy)). Nov 1987. 14p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702998/JAW.

We study the unsteady free convection flow near a moving infinite flat plate in a rotating medium by imposing a time dependent perturbation on a constant plate temperature. The temperatures involved are assumed to be very large so that radiative heat transfer is significant, which renders the problem very nonlinear even on the assumption of a differential approximation for the radiative flux. When the perturbation is small, the transient flow is tackled by the Laplace transform technique. Complete first order solutions are deduced for an impulsive motion. (author). 12 refs, 2 figs.

41743 **(IC—87/385) Unsteady hydromagnetic free-convection flow with radiative heat transfer in a rotating fluid - II: Compressible optically thin fluid.** Bestman, A.R.; Adjepong, S.K. (International Centre for Theoretical Physics, Trieste (Italy)). Nov 1987. 15p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702999/JAW.

We consider the buoyancy-induced flow of an electrically conducting fluid with radiative heat transfer past a vertical flat plate of infinite length. We assume that the density obeys the simple Boussinesq equation of state while the viscosity and thermal conductivity vary with temperature, that is a compressible fluid. If the temperature of the plate is such that a time dependent component is superimposed on a constant value, the problem is tackled by asymptotic approximation. The results are compared and contrasted with those of incompressible flow. (author). 4 refs, 2 figs.

41744 **(IC—87/386) Unsteady hydromagnetic free-convection flow with radiative heat transfer in a rotating fluid of arbitrary optical thickness.** Bestman, A.R.; Adjepong, S.K. (International Centre for Theoretical Physics, Trieste (Italy)). Nov 1987. 11p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703000/JAW.

This paper investigates transient effect on the flow of a thermally radiating and electrically conducting compressible gas in a rotating medium bounded by a vertical flat plate. The transience is provoked by a time dependent perturbation on a constant plate temperature. The problem particularly focusses on an optically thick gas and a gas of arbitrary optical thickness when the difference between the wall and free stream temperatures is small. Analytical results are possible only for limiting values of time and these results are discussed quantitatively. Indeed the assumption of small temperature difference is more appropriate for plates which are opaque rather than transparent. (author). 3 refs.

41745 **(LBL—25259) Higher order vortex methods with rezoning.** Nordmark, H.O. (Lawrence Berkeley Lab., CA (USA)). May 1988. Contract AC03-76SF00098. 86p. NTIS, PC A05/MF A01;1; GPO Dep. Order Number DE88010777/JAW.

The vortex method is a numerical method for approximating the flow of an incompressible, inviscid fluid. We consider the two-dimensional case. The accuracy depends on the choice of the cutoff function which approximates the delta function, on the cutoff parameter δ and on the smoothness of the initial data. We derive a class of infinite-order cutoff functions with arbitrarily high rates of decay at infinity. We also derive an eighth order cutoff function with compact support. We test two versions of rezoning. Version 1 has been suggested and tested by Beale and Majda, while version 2 is new. Using rezoning, we test the eighth order cutoff function and one infinite-order cutoff function on three test problems for which the solution of Euler's equation is known analytically. The accuracies of the two methods are comparable. We also compute the evolution of two circular vorticity patches and the evolution of one square vorticity patch over long time intervals. Finally, we make a comparison between the direct method of velocity evaluation and the Rokhlin-Greengard algorithm. The numerical experiments indicate that for smooth flows, high-order cutoffs combined with rezoning give high accuracy for long time integrations. 27 refs., 28 figs., 10 tabs.

41746 **(SAND—88-0184C) Numerical description of cavitation on axisymmetric bodies.** Hickox, C.E.; Hailey, C.E.; Wolfe, W.P.; Watts, H.A.; Gross, R.J.; Ingber, M.S. (Sandia National Labs., Albuquerque, NM (USA); Iowa State Univ. of Science and Technology, Ames (USA)). 1988. Contract AC04-76DP00789. 20p. (CONF-880740—1). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88006826/JAW.

From Cavitation and multiphase forum; Cincinnati, OH, USA (24 Jul 1988).

This paper reports on ongoing studies which are directed toward the development of predictive techniques for the modeling of steady cavitation on axisymmetric bodies. The primary goal of the modeling effort is the prediction of cavity shape and pressure distribution from which forces and moments can be calculated. Here we present an overview of the modeling techniques developed and compare predictions with experimental data obtained from water tunnel tests for both limited and supercavitation. 14 refs., 4 figs.

41747 **Application of a square function heat pulse to forced flow He II.** Kashani, A.; Van Sciver, S.W. (Univ. of Wisconsin, Madison (USA)). pp 417-424 of Advances in cryogenic engineering. Volume 33. Fast, R.W. (ed.). New York, NY; Plenum Press (1988). (CONF-8706125—). Contract AC02-82ER52077.

From Cryogenic engineering conference; St. Charles, IL, USA (14 Jun 1987).

This paper comprises the third report on a series of experiments involving forced convection heat transfer in He II. A square function heat pulse is applied to the middle of a copper flow tube. Pulse width and amplitude were varied in the experimental runs. Bath temperature was also varied between 1.65, 1.80, and 1.95 K. Bath pressure was kept under saturation pressure. He II flow rate was varied between zero and 80 cm per second. Fluid temperature was monitored at eight locations along the tube. Experimental temperature profiles were compared with a numerical solution to the He II energy equation.

41748 **Low-cost, compact dilution refrigerator: operation from 200 to 20 mK.** Roach, P.R.; Gray, K.E. (Argonne National Lab., IL (USA)). pp 707-712 of Advances in cryogenic engineering. Volume 33. Fast, R.W. (ed.). New York, NY; Plenum Press (1988). (CONF-8706125—). Contract W-31-109-ENG-38.

From Cryogenic engineering conference; St. Charles, IL, USA (14 Jun 1987).

We have developed a self-contained (portable) ^{3}He-^{4}He dilution refrigerator which has been operated below 0.020 K without the use of external pumps or gas handling system. Using charcoal pumps for all pumping, the system requires, besides the usual liquid helium and nitrogen baths, only modest electronics for heaters and thermometers. This device has the advantages of low cost and simple operation and does not require extensive maintenance or operator expertise. The refrigerator can operate below 0.020 K for more than 10 hours before the charcoal pumps need to be recycled.

41749 **Survey of diagnostic tools used in hypervelocity impact studies.** Chhabildas, A.C. (Sandia National Labs., Albuquerque, NM (US)). pp 205-220 of Hypervelocity impact. Anderson, C.E. Elmsford, NY; Pergamon Books Inc. (1987). (CONF-861091—).

From Hypervelocity impact symposium; San Antonio, TX, USA (21 Oct 1986).

This paper surveys a variety of diagnostic tools that are available for use in studies of hypervelocity impact. Emphasis is on time-resolved methods for measuring pressure or particle velocity histories of stress waves induced under these conditions, and on the new developments of the past decade.

41750 **Fragmentation of rapidly expanding jets and sheets.** Grady, D.E. (Sandia National Labs., Albuquerque, NM (US)). pp 285-292 of Hypervelocity impact. Anderson, C.E. Elmsford, NY; Pergamon Books Inc. (1987). (CONF-861091—).

From Hypervelocity impact symposium; San Antonio, TX, USA (21 Oct 1986).

A common consequence of hypervelocity impact phenomena, or other intense loading process, is the creation of rapidly expanding hydrodynamic jets or sheets. Theoretical results are derived for the time to failure and fragment size associated with the catastrophic breakup of jets and sheets. Physical effects leading to the enhanced ductility of materials during dynamic expansion are discussed. Theoretical results are compared with impact plumes and shaped-charge jets.

41751 **Review of hypervelocity penetration theories.** Herrmann, W.; Wilbeck, J.S. (Engineering Sciences Directorate, Sandia National Labs. (US)). pp 307-322 of Hypervelocity impact. Anderson, C.E. Elmsford, NY; Pergamon Books Inc. (1987). (CONF-861091—).

From Hypervelocity impact symposium; San Antonio, TX, USA (21 Oct 1986).

A review is given of the empirical and approximate theoretical expressions which have been developed to describe various aspects of impact at hypervelocities where the projectile and some of the target materials undergo massive plastic deformation, breakup, melting or vaporization. Various stages of the penetration process are identified on the basis of experimental evidence. Empirical fits to experimental data, or, at velocities above the experimental range, to results of finite difference calculations of the penetration event, are reviewed. In some cases simple theories, usually requiring the evaluation of some undetermined parameters from experimental or numerical data, have been developed. These are described, with emphasis on those which have found use in the design of offensive or defensive systems.

41752 **Theoretical equation of state for aluminum.** Kerley, G.I. (Sandia National Labs., Albuquerque, NM (US)). pp 441-450 of Hypervelocity impact. Anderson, C.E. Elmsford, NY; Pergamon Books Inc. (1987). (CONF-861091—).

From Hypervelocity impact symposium; San Antonio, TX, USA (21 Oct 1986).

Theoretical methods for calculating equations of state are discussed and applied to aluminum. The model incudes a treatment of melting, vaporization, and thermal electronic excitation. The thermal electronic terms are shown to cause a plasma phase transition in the hot expanded fluid, affecting the unloading behavior from shocked states. The calculations give good agreement with experimental Hugoniot data, the melting curve, and isobaric expansion measurements.

41753 **Energy flow in relativistic beam-plasma interactions.** Main, W.T. Irvine, CA; Univ. of California (1987). 104p. University Microfilms Order No. 87-19,502.

Thesis (Ph. D.).

The experiment was performed with a 600-keV Marx generator system capable of producing current pulses from 0.5 to 15 kA. The beam was injected into a clear lucite interaction chamber filled with 10-mT helium pre-ionized to n/sub p/ = 2 x 10^{12}cm^{-3}. A 1-2 kG axial-guide field was used. Radiation with peak power up to 280 kW and peak efficiency of 3 x 10^{-5} was observed. In the short 300-ns shots, the emission persisted throughout the current pulse. In the long 1800-ns shots the emission cutoff after ~ 1000 ns, well before the beam current reached its peak. To understand this beam-plasma system, a model was made that used a 30-mode Langmuir wave spectrum from k = 7 cm^{-1} to 120 cm^{-1} and one EM mode. The energy transfer between these modes was controlled by instability rates derived from the linear and nonlinear dispersion relations. Also considered was the Langmuir wave energy lost to heating by induced return current acting on the anomalous resistivity. In the model, uniform beam and plasma density and ideal beam propagation were assumed. Three observables were used to test the validity of the model: emission, ionization, and RMS plasma electric field.

41754 **Large electric fields in a magnetized plasma sheath; Long-lived vortices.** Theilhaber, K.; Birdsall, C.K. (Univ. of California, Berkeley, CA (US)). pp 100-101 of The 1987 IEEE international conference on plasma science (Abstracts). Piscataway, NJ; IEEE Service Center (1987). (CONF-870651—).

From IEEE international conference on plasma science; Crystal City, VA, USA (1 Jun 1987).

The authors consider the equilibrium and time-dependent behavior of the plasma-wall sheath which is formed when the external magnetic field is parallel to the wall. The presence of the material boundary initially creates a layer of charge depletion near the surface, of thickness comparable to the ion gyro-radius. This results in a strongly nonuniform electric field which induces a sheared EXB motion of ions and electrons parallel to the wall. Physical arguments as well as analytical and numerical studies suggest that this

flow is subject to the Kelvin-Helmholtz instability, with a long-term evolution into a set of vortices separating the boundary from the plasma. The authors present an analytical model for the instability, and the results of two-dimensional, electrostatic particle simulations of this configuration, in the form of a movie, showing initialization of E, the subsequent shear motion, and the buildup near the wall of vortices which live (at least) some 10's of ion gyroperiods.

6450 High Energy Physics

REFER ALSO TO CITATION(S) 41923

41755 (BNL—52114, pp 6-14) Keynote address. Weisskopf, V.F. (Massachusetts Institute of Technology, Cambridge (USA)). 1987. NTIS, PC A19/MF A01. Order Number DE88008012/JAW. (CONF-8710107—).

From Future perspectives in high energy physics; Upton, NY, USA (5 Oct 1987).

High energy physics can be divided into three parts: (1) accelerator construction; (2) experimental physics; and (3) theory. Accelerator construction went through a decisive change from fixed-target machines to colliders, both of proton with protons or antiprotons, and of electrons with positrons. The author feels personal pride from having taken part in planning and realizing the first p-p collider, the ISR. It was called a window to the future. But that future is here! almost all machines under construction, planned or studied, are now colliders. A striking development in experimental physics was the introduction of new kinds of detectors, wire chambers, drift chambers and other devices that allow direct electronic registering and immediate computer evaluation. The experimental results during the last 15 years were impressive: the third electron, two new quarks, the discovery of neutral currents, of the W and Z boson and other confirmations of the electro-weak theory, the deep inelastic scattering by nucleons of electrons, neutrinos, and x-rays, which gave them direct evidence of the existence of quarks and a deeper insight into the inner structure of hadrons. It consists of the electro-weak theory that establishes a connection between electromagnetism and weak interactions, and quantum chromodynamics, the theory of strong interactions.

41756 (CRN-RA—1986) CRN: 1986 progress report. (Strasbourg-1 Univ., 67 (France). Centre de Recherches Nucleaires). 1987. 307p. (In French). NTIS (US Sales Only), PC A14/MF A01. Order Number DE88752445/JAW.

Departments activities in high energy physics, nuclear physics, radiation physics and chemistry are reported. Collaboration with university led to creation of SRNU (Service du Reacteur Nucleaire). Vivitron studies are presented.

41757 (DOE/ER/02271—111) Theoretical high energy physics: Progress report, May 1, 1987-April 30, 1988. Lee, T.D. (Columbia Univ., New York (USA). Dept. of Physics). May 1988. Contract AC02-76ER02271. 24p. (COO—2271-111). NTIS, PC A03/MF A01;1; GPO Dep. Order Number TI88010563/JAW.

This paper discusses the progress on High Energy Physics projects by the facility of Columbia University. Short discussions are given on the use of parallel computers for numerical simulation of lattice quantum chromodynamics; Soliton condensation; High Temperature superconductivity; New calculations techniques for non-Abelian gauge theories and other related topics. (LSP)

41758 (DOE/ER/40125—13) Indiana University high energy physics, Task A: Technical progress report, December 1, 1987-November 30, 1988. Brabson, B.B.; Crittenden, R.R.; Dzierba, A.R.; Martin, H.J.; Ogren, H.O.; Zieminski, A. (Indiana Univ., Bloomington (USA). Dept. of Physics). 1988. Contract AC02-84ER40125. 105p. NTIS, PC A06/MF A01;1; GPO Dep. Order Number DE88010705/JAW.

This year at Brookhaven data from last year's run on the production of the KKπ system by π's, K's and antiprotons was analyzed. Analysis of the Fermilab fixed-target jet experiment, E557, resulted in 3 publications. In addition two conference contributions were prepared and a third paper will be written. Otherwise E557 is finished. A dimuon detector for E672 was installed and tested. This took place in early 1987. Data were from June, 1987 to February, 1988. Some 800 tapes of triggers (about 10K/tape) are in hand with data from both the E672 and E706 apparatus. We participated in the coordination and writing of software for the D0 collider detector at Fermilab. We will be increasing our efforts in D0. Data-taking with the High-Resolution Spectrometer (HRS) at SLAC is completed. This year 12 publications resulted. More are in preparation. Hardware was built for the muon upgrade for the Mark2 detector at the SLC. Beam position monitors for the SLC are being built and also working on 308/E microprocessors for Mark2 data analysis. At SLAC we are also involved in the SLC Polarization Collaboration.

41759 (EP-LPNHE-X-RA—1985) Progress report: 1985. Laboratory of high energy nuclear physics. (Ecole Polytechnique, 91 - Palaiseau (France). Lab. de Physique Nucleaire et des Hautes Energies). 1986. 20p. (In French). (LPNHEX-RA—1985). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88752432/JAW.

Main research themas are experimental studies of elementary constituents of matter (quark, leptons,...) and of their fields (photons, gluons,...). Experiments in which the LPNHE (laboratory of high energy nuclear physics) participates are, at CERN, NA (4), NA (10), UA (7), NA (38); it collaborates at Modane to determination of proton mean life. It participates to Aleph experiment at Lep, and to studies aimed at H1 calorimeter construction at Hera. Different technical developments are going on; among them, the study of special detectors which use liquids at ambient temperature for charged particles. A group is aimed at fabrication and study of thin films of amorphous silicon and amorphous silicon-germanium alloys. A specialized reactor, the Arcam, allows stocking of thin films with different compositions.

41760 (LAL-RA—1983-85) Linear Accelerator Laboratory progress report: July 1983-October 1985. (Paris-11 Univ., 91 - Orsay (France). Lab. de l'Accelerateur Lineaire). 1987. 210p. (In French). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88752444/JAW.

Different experiments presented are Asterix at Lear (CERN), DM2 at DCI (Orsay), NA3 and NA9 at SPS (CERN), NA9 at SPS, Cello at Desy (Hamburg), NA14 and NA31 at SPS, UA2 at SpantipS (CERN), the experiment "proton meanlife" at the underground laboratory of Modane. Experiments in preparation are Aleph (Lep), Delphi (Lep), H1. Technical projects are researches in acceleration techniques, experimental data acquisition with Fastbus standard and event analysis in 3D graphics.

41761 (SLAC—328) Looking beyond the Z: Proceedings. Feldman, G.J.; Gilman, F.J.; Leith, W.G.S.; Brennan, E.C. (Stanford Linear Accelerator Center, Menlo Park, CA (USA)). Jan 1988. Contract AC03-76SF00515. 679p. (CONF-870821—). NTIS, PC A99/MF A01;1; GPO Dep. Order Number DE88011870/JAW.

From SLAC summer institute on particle physics: looking beyond the Z; Stanford, CA, USA (10 Aug 1987).

Separate abstracts were prepared for 31 lectures and conference papers in these proceedings. (LEW)

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Experimental

REFER ALSO TO CITATION(S) 40809, 40809, 40905, 41049, 41086, 41088, 41937

41762 (ANL-HEP-CP—87-70) Inclusive {eta} production in {tau} decays. Abachi, S.; Akerlof, C.; Baringer, P.; Blockus, D.; Brabson, B.; Brom, J.M.; Bylsma, B.G.; Chapman, J.; Cork, B.; De Bonte, R.; Derrick, M.; Errede, D.; Jung, C.; Ken, M.; Koltick, D.S.; Kooijman, P.; Loos, J.S.; Low, E.H.; McIlwain, R.L.; Meyer, D.I.; Miller, D.H.; Musgrave, B.; Neal, H.; Ng, C.R.; Nitz, D.; Ogren, H.; Paik, H.W.; Price, L.E.; Rangan, L.K.; Repond, J.; Rust, D.R.; Shibata, E.I.; Sugano, K.; Thun, R.; Tschirhart, R. (Argonne National Lab., IL (USA); Indiana Univ., Bloomington (USA); Michigan Univ., Ann Arbor (USA); Purdue Univ., Lafayette, IN (USA); Lawrence Berkeley Lab., CA (USA)). 1987. Contract W-31109-ENG-38. 12p. (PU—87-601; IUHEE—87-09; UM-HE—87-16; CONF-870797—14; CONF-870797—). NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88009968/JAW.

From International symposium on lepton and photon interactions at high energies; Hamburg, F.R. Germany (27 Jul 1987).

We have searched for inclusive eta production in tau decays using a sample of 2553 events of e$^+$e/sup minus/ → {tau}$^+${tau}/sup minus/ in the one-three topology. The data were taken with the High Resolution Spectrometer at $\sqrt{s}$ = 29 GeV. Our results are based on an analysis of the $\pi^+\pi$/sup minus/ invariant mass spectrum to find the narrow peak resulting from the decay sequence {tau} → {eta}x and {eta} → $\pi^+\pi$/sup minus/π{degree}. No clear peak is observed and a 90% confidence upper limit on the process {tau} → {eta}x of 2.1% is found. For decays {tau} → {eta}{eta}x the 90% confidence upper limit is 1.3%. Our best limit on {tau} → {eta}{eta}x is obtained from tau decay to five charged particles with a 90% confidence level upper limit of 0.5%.

41763 (CEA-N—2558) Study of three jet events production in proton-antiproton collisions at the CERN SPS collider. Polverel, M. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Dept. de Physique des Particules Elementaires; Paris-11 Univ., 91 - Orsay (France)). Mar 1988. 158p. (In French). NTIS (US Sales Only), PC A08/MF A01. Order Number DE88754050/JAW.

This thesis presents the study done in the UA2 experiment of events with three large momentum jets of particles. We show that these events are well described by a theoretical model based on leading order Quantum Chromodynamics (QCD) calculations. In this theory, the ratio of the number of 2-jet events to the number of 3-jet events is proportional to the strong coupling constant α(S). We have adjusted this parameter in the model in order to reproduce the observed ratio. In fact, higher order QCD corrections permit only a determination of the strong coupling constant α(S) multiplied by a ratio of "K-factors" (K3 over K2) involved in 3-jet and 2-jet production. A study of the systematic errors give the final result: 0.22 +- 0.01 (Stat.) +- 0.04 (Syst.). We compare this value to the results of other recent CERN experiments in nucleon collisions, and discuss it together with other experimental determinations of α(S).

41764 (CERN-EP—87-154) W and Z physics and the Standard Model. Locci, E. (European Organization for Nuclear Research, Geneva (Switzerland)). 26 Aug 1987. 20p. (CONF-870632—16). NTIS (US Sales Only), PC A03;1; GPO Dep. Order Number DE88012589/JAW.

From International Europhysics conference on high energy physics; Uppsala, Sweden (25 Jun 1987).

Final results on production cross-sections and on the masses of the W and Z gauge bosons observed by the UA1 experiment at the CERN p{bar p} Collider are presented. Parameters derived from these data are compared with the predictions of the minimal Standard Model and of QCD. 13 refs., 3 figs., 6 tabs.

41765 (CERN-EP—87-174) Measurements of standard electroweak model parameters. Blondel, A. (European Organization for Nuclear Research, Geneva (Switzerland)). 25 Sep 1987. 30p. (CONF-870390—13). NTIS (US Sales Only), PC A03; 1; GPO Dep. Order Number DE88012595/JAW.

From 22. Recontres de Moriond: electroweak interactions and unified theories conference; Les Arcs, France (8 Mar 1987).

Determinations of the Standard Electroweak Model parameters are now available from complementary sources with a precision sufficient to be sensitive to electroweak radiative corrections. They permit an estimation of sin^2 θ/sub w/, {rho}, Δr, and the setting of limits in particular on the mass of the top quark. The present value of Standard Model parameters is somewhat in disagreement with the minimal SU(5) prediction. In the near future, dramatic improvement should come from precision measurements at the SLC and LEP, for which the availability of longitudinal polarization at the Z pole is shown to be essential. 54 refs., 7 figs.

41766 (DOE/ER/03130—40C) A research program in experimental high energy physics: Task C, Progress report. Lanou, R.E. Jr.; Cutts, D. (Brown Univ., Providence, RI (USA). Dept. of Physics). 1 Jul 1988. Contract AC02-76ER03130. 47p. (COO—3130TC-40). NTIS, PC A04. Order Number DE88012762/JAW.

An experimental program in strong and electro-weak interaction physics of elementary particles is being carried out using electronic detection techniques. Experiments have been performed at Brown, Brookhaven, and Fermilab. The work described in this report by the /electronic Detector Group addresses the following: electroweak parameters via neutrino interactions, preparations for experiments ("D-ZERO") at the FNAL 2 TeV {bar p}p Collider, new detection techniques for neutrino properties.

41767 (IFVE-OEIUNK—87-7) Precision measurement of M/sub W,Z/ at hadron colliders and restrictions on H boson ant t quark masses. Alekhin, S.I. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1987. 7p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88703184/JAW.

Submitted to the journal Sov. J. Nucl. Phys. .

Opportunities for precise measurements of W and Z boson masses at future hadron colliders are considered. Estimation on precesion for sin/sup 2/Θ/sub W/, determined throug M/sub W//M/sub Z/ ratio are obtained. It is shown that the precision of order 0.001 is accessible in experiments at UNK-collider. This provides a possibility to extract the contribution from H boson and t quark in radiative corrections for Z mass, if M/sub H/ > 200 GeV, M/sub t/ > 60 GeV. 11 refs.; 1 fig.; 2 tabs.

41768 (IFVE-OEIUNK/OMVT—87-26) HECAS analytical calculation system. Input language description. Grudtsin, S.N.; Larin, V.N. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1987. 52p. (In Russian). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88701590/JAW.

The HECAS analytical calculation system for high energy physics is described. This system deals with the expressions, containing the scalars, scalar functions, vectors tensors, σ-, γ- and λ-matrices and special objects, as well as with vectors and matrices, composed of such expressions. The system is written in FORTRAN and is highly machine-independent. 8 refs.; 1 figs.; 2 tabs.

41769 (ITEF—108(1987)) Measurement of K/sup -/ -> μ/sup +/$\nu\gamma$ decay probability. Barmin, V.V.; Barylov, V.G.; Davidenko, G.V. and others. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1987. 8p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88703300/JAW.

K/sup +/ -> μ/sup +/$\nu\gamma$ decay is observed on the photographs of the 180-liter xenon bubble chamber. Probability of internal bremstrahlung Γ (K/sup +/ -> μ/sup +/$\nu\gamma$, IB)/Γ(K/sup +/)=(3.22+-0.46)x10/sup -3/ with ≧20 MeV γ-quanta energies is

measured. This result agrees with the calculation of quantum electrodynamics. 10 refs.; 3 figs.

41770 **(ITEF—112(1987)) Cross sections of the strange particle production channels in π/sup +/P interaction at P=4.23 GeV/c.** Drutskoj, A.G.; Mikhajlichenko, V.I.; Nikitin, S.Ya.; Kiselevich, I.L.; Shidlovskij, A.V. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1987. 10p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88703301/JAW.

Cross sections of reaction channels with production of strange particles in PI/sup +/p-interaction for an incident PI/sup +/-meson momentum of 4.23 GeV/c are determined. The procedures for determination of topological cross sections, introduction of corrections and calculations of channel cross sections and their errors are described in detail. The total cross section for strange particle production through all the channels made up 1.765?-0.050 mb. 10 refs.; 2 figs.; 2 tabs.

41771 **(ITEF—126(1987)) Energy- and A-dependence of cumulative Λ/sup 0/-particle yields at 90 deg angle in laboratory system.** Vorob'ev, L.S.; Gavrilov, V.B.; Goryainov, N.A. and others. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1987. 15p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703305/JAW.

Electron technique was used to study for the first time the energy and A-dependences of yields of cumulative Λ/sup 0/-particles, emitted at the angle of 90 deg. These dependences repeat the corresponding ones for cumulative nucleons in general terms. Absolute values of cumulative Λ/sup 0/-particle yields were measured and discussed. 8 refs.; 8 figs.

41772 **(ITEF—137(1987)) Detection of resonance with mass 3075 MeV/c/sup 2/ and spin 4 in the π/sup -/p -> K/sub s//sup 0/K/sub s//sup 0/n reaction at incident momentum 40 GeV/c.** Baloshin, O.N.; Bolonkin, B.V.; Vladimirskij, V.V. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1987. 7p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702815/JAW.

The resonance with the mass 3075+-30 MeV/c/sup 2/, width 170+-80 MeV/c/sup 2/ and spin 4 was found in the π/sup -/p -> K/sub S//sup 0/K/sub S//sup 0/n reaction by incident momentum 40 GeV?c. 7 refs.; 3 figs.

41773 **(ITEF—143(1987)) Possible experiments at antiproton accelerator with energy from 1 GeV up to tens GeV.** Ioffe, B.L. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1987. 24p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703311/JAW.

Possible experiments, which may be conducted at 1-60 GeV antiproton accelerator are considered. Special attention is paid to production of charmonium states and exotic states as resonances in the direct channel of p-barp-annihilation as well as test of quantum chromodynamics in hard processes. 29 refs.

41774 **(JINR—E-1-87-265) Production of D-bar/sup 0/ and D/sup -/ mesons in neutron-carbon interactions at 40-70 GeV.** Aleev, A.N.; Aref'ev, V.A.; Balandin, V.P. (Joint Inst. for Nuclear Research, Dubna (USSR)). (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1987. 12p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703072/JAW.

Submitted to the journal Z. Phys., C.

The production of D-bar mesons in neutron-carbon interactions at 40-70 GeV/c has been investigated. The D-bar mesons were detected via the hadronic decay modes D-bar/sup 0/ -> K/sup +/$(892)\pi$/sup -/π/sup -/. In the kinematic region $x > 0.5$ and p/sub T/ < 1 GeV/c the following inclusive cross sections were measured: σ(D-bar/sup 0/)=(28 +- 14) μb and σ(D/sup -/)=(26 +- 13) μb per carbon nucleus. The invariant longitudinal momentum spectra can be described by (1-x)/sup N/ with N(D-bar/sup 0/)=1.1 +- 0.5 +- 0.4 and N(D/sup -/)=0.8 +- 0.4 +- 0.4. The transverse momentum spectra were parametrized by exp (-Bxp/sub T//sup 2/) with B equal to ((1.2+1.1)-(1.2-0.9)) and ((1.8+1.3)-(1.8-1.0)) for D-bar/sup 0/ and D/sup -/ respectively. 29 refs.; 7 figs.; 1 tab.

41775 **(JINR—R-1-87-308) Observation of the decays of charmed D-mesons and Σ/sub c//sup ++/ (2450) baryon produced in neutrino-nuclear emulsion interactions.** Batusov, Yu.A.; Bunyatov, S.A.; Kuznetsov, O.M. (Joint Inst. for Nuclear Research, Dubna (USSR)). (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1987. 12p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703076/JAW.

Submitted to the journal Sov. J. Nucl. Phys. .

The results are presented on the experimental search and analysis of decays of charmed particles produced in neutrino-emulsion interactions. In the present experiment cryogenically sensitive BR2 emulsions were placed into Fermilab 15-foot bubble chamber and were exposed in the broad energy spectrum (10-200 GeV) neutrino beam. The method of the search for the interactions by using a track following technique in a horizontally exposed pellicles in hybrid experiments is considered. The decays of Λ/sub c//sup +/-baryon, D/sup +/ and two D/sup 0/-mesons are found. The event with Λ/sub c//sup +/-decay is interpreted as a production and decy of a charmed baryon resonance Σ/sub c//sup ++/(2450) on Λ/sub c//sup +/π/sup +/. 11 refs.; 3 figs.; 3 tabs.

41776 **(JINR-R—1-87-311) Momentum and angular characteristics of π/sup -/-mesons produced in np, pp, nC and nTa interactions at momentum P/sub 0/=4.2 GeV/c.** Bekmirzaev, R.N.; Muminov, M.M.; Grishin, V.G.; Ivanovskaya, I.A.; Dolejshi, I.; Trka, Z.; Prokopieva, S.A. (Samarkandskij Gosudarstvennyj Univ. (USSR); Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy; Karlova Univ., Prague (Czechoslovakia); Vissh Massinno-Elektrotekhnicheski Inst., Sofia (Bulgaria)). (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1987. 14p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703374/JAW.

Submitted to the journal Sov. J. Nucl. Phys. .

A comparative analysis of momentum and angular characteristics of π/sup -/-mesons produced in neutron interactions with protons and with carbon and tantalum nuclei at a momentum of 4.2 GeV/c is presented. An essential role in the π/sup -/-meson production of channels with neutron dissociation as well as secondary rescattering in the nucleus is shown. The experimental results are compared with the intranuclear cascade model calculations. 14 refs.; 9 figs.; 4 tabs.

41777 **(JINR-R—1-87-652) Study on the fast neutron production (p/sub n/$\geqq$1GeV/c) in pp and p/sup 12/C interactions at p/sub p/=4.2 GeV/c.** Bekmirzaev, R.N.; Grishin, V.G.; Grishina, O.V. and others. (Samarkandskij Gosudarstvennyj Univ. (USSR); Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy; Moskovskij Gosudarstvennyj Univ. (USSR). Nauchno-Issledovatel'skij Inst. Yadernoj Fiziki). (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1987. 11p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703378/JAW.

Submitted to the journal Sov. J. Nucl. Phys. .

Multiplicity, momentum and angular distributions for secondary fast neutrons (N/sub n//sup F/) in pp and p/sup 12/C interactions at P=4.2 GeV/c have been obtained by analyzing the secondary neutral stars generated by neutrons with $p \geqq 1$ GeV/c in a propane (C/sub 3/H/sub 8/) bubble chamber. These data on pp interactions are compared with the calculations on Lund model, and those on p/sup 12/C interactions are compared with the Dubna version of cascade model (DCM). These results are compared with the data of previous analogous studies on π/sup -/p, pp interactions within the 4-300 GeV/c momentum range. It is shown that the coefficient of inelastic nucleon charge exchange a(p->n) in π/sup -/p and pp interactions is approximately constant and does not depend

on primary energy and on type (π/sup -/p or pp) of interaction. The calculations on DCM and Lund model satisfactorily describe the experimental data. 16 refs.; 4 figs.; 6 tabs.

41778 **(JINR-R—2-87-118) On a statistical nature of dibaryon resonances.** Bazhanskij, I.I.; Luk'yanov, V.K.; Titov, A.I. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1987. 15p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703380/JAW.

Submitted to the journal Sov. J. Nucl. Phys. .

It is shown that in the case when dibaryon resonances are overlapped and have a comparatively large width and density, there appear fluctuations in the cross sections of the corresponding processes where nucleon-nucleon channels are important. The available experimental data do not contradict the above assumption. 26 refs.; 5 figs.; 1 tab.

41779 **(LA—11248-C) Proceedings of the twenty-first LAMPF users group meeting.** (Los Alamos National Lab., NM (USA)). Apr 1988. Contract W-7405-ENG-36. 204p. (CONF-8711185—). NTIS, PC A10/MF A01;1; GPO Dep. Order Number DE88010480/JAW.

From 21. LAMPF Users Group meeting; Los Alamos, NM, USA (9 Nov 1987).

The Twenty-First Annual LAMPF Users Group Meeting was held November 9-10, 1987, at the Clinton P. Anderson Meson Physics Facility. The program included a number of invited talks on various aspects of nuclear and particle physics as well as status reports on LAMPF and discussions of upgrade options. The LAMPF working groups met and discussed plans for the secondary beam lines, experimental programs, and computing facilities.

41780 **(LUNFD6/NFFL—7037/1987) Production of positrons with low transverse momentum and low-mass electron-positron pairs in proton-proton collisions at a center-of-mass energy of 63 GeV.** Hedberg, V. (Lund Univ. (Sweden). Dept. of Physics). 31 Mar 1987. 154p. NTIS (US Sales Only), PC A08/MF A01. Order Number DE88752692/JAW.

The production of inclusive prompt positrons in pp collisions at $\sqrt{s}$ = 63 GeV and y=0 has been measured over the P/sub T/ interval 0.08 < P/sub T/ < 1.0 GeV/c. The e/sup +//π ratio rises with decreasing P/sub T/ to $\simeq$ 1.6 x 10/sup -3/ at P/sub T/ = 0.1 GeV/c. A measurement of low-mass e/sup +/e/sup -/ pairs (0.05 < m/sub ee/ < 0.60 GeV/c/sup 2/) has also been performed. It is found that the observed rise of the e/sup +//π ratio can be explained by the low-mass continuum. The origin of this pair continuum, which has been observed by several previous experiments, has so far been unclear. In order to obtain some new insight into the possible production mechanism a measurement of the production of single positrons and electron-positron pairs as a function of the associated charge multiplicity has been carried out. The results indicate that the production of low-P/sub T/ positrons (<0.4 GeV/c) and low-mass pairs is proportional to the square of the mean multiplicity in the central region (vertical strokeyvertical stroke<1). Such a quadratic dependence is not expected from final-state sources such as hadronic bremsstrahlung or hadronic decays but is predicted by models where low-mass electron pairs are produced by interactions of constituents created during the collision.

41781 **(OH/RD—87/196/K) Electromagnetic interference (EMI) investigation - Ear Falls GS to Manitoba Falls GS to Manitou Falls GS [Generating Station] radio system.** Goldthorpe, D.R. (Ontario Hydro Research Div., Toronto (Canada)). 15 Sep 1987. 6p. Ontario Hydro Research Division, Editorial Section, 800 Kipling Ave., Toronto, Ont., Canada M8Z 5S4; $10.00 CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

Tests were conducted in order to locate the EMI sources affecting the Ear Falls GS radio link. Measurements were also performed to compare the noise levels at the existing location of the transmitting and receiving antenna tower to the noise at a proposed new location approximately 73 metres west of the station. Test results are summarized.

41782 **(SLAC-PUB—4599) Graduate education and research in the ERA of large accelerators.** Perl, M.L. (Stanford Linear Accelerator Center, Menlo Park, CA (USA)). Apr 1988. Contract AC03-76SF00515. 11p. (CONF-880289—1). NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88010681/JAW.

From 3. topical conference of departmental chairs: American Association of Physics Teachers; Arlington, VA, USA (19 Feb 1988).

Questions and concerns of the experimental particle physics community are addressed in these categories: quality of research, independence, creativity, evaluation and recognition, and value in graduate education. (LEW)

41783 **(SLAC-PUB—4632) The tau decay mode problem.** Perl, M.L. (Stanford Linear Accelerator Center, Menlo Park, CA (USA)). May 1988. Contract AC03-76SF00515. 24p. (CONF-880288—1). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88012736/JAW.

From Les Recontres de Physique; La Thuile, Italy (28 Feb 1988).

The problem of understanding the branching fractions of the 1-charged particle decay modes of the {tau} lepton is reviewed. The emphasis is on a recent study by K.G. Hayes and M.L. Perl of the statistical validity of the branching fraction measurements. Unconventional explanations of the problem, none of them satisfactory, are also discussed. 25 refs., 4 tabs.

41784 **(SLAC-PUB—4635) B meson reconstruction and lifetime studies with the Mark II at PEP.** Wagner, S.R. (Colorado Univ., Boulder (USA). Dept. of Physics; Stanford Linear Accelerator Center, Menlo Park, CA (USA)). May 1988. Contract AC02-86ER40253;AC03-76SF00515;AC03-76SF00098;AC02-84ER40125;AC03-81ER40050;AC03-83ER40103. 9p. (CONF-8803109—3; COLO-HEP—177). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88012737/JAW.

From 23. Rencontre de Moriond conference: electroweak interactions and unified theories; Les Arcs, France (6 Mar 1988).

We have measured the lifetime of an ensemble of particles containing b quarks, tagged with a high p/sub T/ lepton from their semileptonic decay. Using a method which estimates the production point of each particle in the beam ellipse, we measured a lifetime of 0.98 +- 0.12 +- 0.13 psec. We have also studied methods of partially reconstructing B mesons decaying into D{sup{star}{minus}} mesons plus charged leptons or mesons. We have searched the Mark II PEP data samples and find five candidates for B^0 decay. Four of these B^0 candidates form good vertices, and their measured proper lifetimes are presented. 18 refs.

41785 **(SLAC-PUB—4639) First results from ASP on resonance production in $\gamma\gamma$ interactions.** Roe, N. (Stanford Linear Accelerator Center, Menlo Park, CA (USA)). May 1988. Contract AC03-76SF00515. 3p. (CONF-8804147—1). NTIS, PC A02/MF A01;1; GPO Dep. Order Number DE88010686/JAW.

From 8. international workshop on photon-photon collisions; Shoresh, Israel (24 Apr 1988).

The reaction e{sup +}e{sup -}{yields}e{sup +}e{sup -}{gamma{sup *}{gamma{sup *}}{yields}(e{sup +}e{sup -}){eta}, with subsequent decay of the {eta} into two photons, has been observed with the ASP detector at the PEP e{sup +}e{sup -} storage ring at {radical} s=29 GeV. A measurement of the radiative width of the {eta} yields the preliminary result {Gamma}({eta}{yields}{gamma}{gamma}) = .489 {+-} .009 {+-} .055 keV. Evidence for the production of the {eta}' with decay into two photons has also been observed.

41786 **Inclusive lepton production in e^+e^- annihilation at 29 GeV.** Ong, R.A.; Weir, A.J.; Abrams, G.S.; Amidei, D.; Baden, A.R.; Barklow, T.; Boyarski, A.M.; Boyer, J.; Burchat, P.R.; Burke, D.L. (Stanford Linear Accelerator Center, Stanford University, Stanford, California 94309). *Physical Review Letters;* **60**: No. 25, 2587-2590(20 Jun 1988).

We use data taken by the Mark II detector at the SLAC storage ring PEP to study inclusive lepton production in e^+e^- annihilation at 29 GeV. From fits to the inclusive lepton momentum and transverse-momentum spectra we measure the semileptonic branching ratios for charm and bottom hadrons. We also determine with good precision the mean value of the bottom fragmentation function using both electron and muon samples.

41787 **Limit on anti ν/sub e/ mass from free molecular tritium beta decay.** Wilkerson, J.F.; Bowles, T.J.; Knapp, D.A.; Maley, M.P.; Robertson, R.G.H.; Wark, D.L. (Los Alamos National Lab., NM (USA)). *Nuclear Physics [Section] A;* **478**: vp(Feb-Mar 1988). (CONF-870413—).

From 11. international conference on particles and nuclei; Kyoto, Japan (20 Apr 1987).

The beta spectrum of free molecular tritium has been measured in order to search for a finite electron antineutrino mass. The final-state effects in molecular tritium are accurately known and the data thus yield an essentially model-independent upper limit of 27 eV on the anti ν/sub e/ mass at the 95% confidence level. This limit is dominated by the statistics obtained in the data sets. Optimization of the experimental apparatus is underway and an ultimate sensitivity of 10 eV is expected.

41788 **NN elastic scattering experiments with polarized beams.** Shima, T. (Argonne National Lab., IL (USA)). *Nuclear Physics [Section] A;* **478**: vp(Feb-Mar 1988). (CONF-870413—). Contract W-31-109-ENG-38.

From 11. international conference on particles and nuclei; Kyoto, Japan (20 Apr 1987).

We report updated analysis results on an np elastic experiment at LAMPF and a pp experiment at the ZGS. We have measured two np spin asymmetry parameters, C/sub LL/ and C/sub SL/, at beam energies 500, 650, and 800 MeV. The c.m. scattering angles of neutrons measured ranged from 80/sup 0/ through 180/sup 0/. We observed very large C/sub LL/ at backward angles for the first time. The pp experiment at the ZGS was a measurement of the difference between the pp total cross sections for parallel and antiparallel longitudinal spin states at beam momenta 2.75, 2.92, 3.25, 3.75, and 4.00 GeV/c. These results reveal possible new structures in this momentum range. Masses for these structures are about 2700 and 2900 MeV.

41789 **Tau decay events involving eta mesons.** Sugano, K.; Derrick, M.; Kooijman, P.; Loos, J.S.; Musgrave, B.; Price, L.E.; Repond, J.; Blockus, D.; Brabson, B.; Brom, J.M. (Argonne National Lab., IL (USA)). *Nuclear Physics [Section] A;* **478**: vp(Feb-Mar 1988). (CONF-870413—). Contract W-31-109-ENG-38;AC02-76ER01112;AC03-76SF00098;AC02-76ER01428;AC02-84ER40125.

From 11. international conference on particles and nuclei; Kyoto, Japan (20 Apr 1987).

The characteristics of tau decays to final states involving eta mesons are presented. The data sample, which corresponds to an integrated luminosity of 300 pb/sup -1/, was taken at the PEP e/sup +/e/sup -/ colliding beam facility using the High Resolution Spectrometer. The storage ring was operated at $\sqrt{s}$ = 29 GeV. The eta production appears to be only compatible with the decay tau/sup +/ -> π/sup +/etaanti ν, which violates isospin and G-parity conservation. This decay, thus, proceeds via a second-class vector current. The branching ratio (5.1+-1.5)% explains much of the current discrepancy between the one-prong topological branching ratio and the sum of the individual one-prong modes.

41790 **Use of new computer technologies in elementary particle physics.** Gaines, I.; Nash, T. (Advanced Computer Program, Fermi National Accelerator Lab., Batavia, IL 60510 (US)). pp 177-212 of Annual review of nuclear and particle science, Volume 37. Jackson, J.D. Palo Alto, CA; Annual Reviews Inc. (1987).

Elementary particle physics and computers have progressed together for as long as anyone can remember. The symbiosis is surprising considering the dissimilar objectives of these fields, but physics understanding cannot be had simply by detecting the passage of particles. It requires a selection of interesting events and their analysis in comparison with quantitative theoretical predictions. The extraordinary reach made by experimentalists into realms always further removed from everyday observation frequently encountered technology constraints. Pushing away such barriers has been an essential activity of the physicist since long before Rossi developed the first practical electronic AND gates as coincidence circuits in 1930. This article describes the latest episode of this history, the development of new computer technologies to meet the various and increasing appetite for computing of experimental (and theoretical) high energy physics.

41791 **An upper limit on the flux of extraterrestrial neutrinos. The IMB collaboration.** Bionta, R.M.; Blewitt, G.; Bratton, C.B.; Casper, D.; Chrysicopoulou, P.; Ciocio, A.; Claus, R.; Cortez, B.; Park, H.S.; Wuest, C. (Univ. of California, Irvine, Irvine, CA (US)). pp 32-41 of Proceedings of the seventh workshop on grand unification/ICOBAN '86. Arafune, J. Teaneck, NJ; World Scientific Pub. Co. (1987). (CONF-8604202—).

From 7. workshop on grand unification; Toyama City, Japan (16 Apr 1986).

The flux of upward-going muons with energy > 2 GeV is measured to be consistent with that expected from atmospheric neutrino interactions. Using a list of known strong astrophysical x-ray and gamma ray sources, the number of upward-going muon tracks arriving within an angular circle about each source is compared with the number of tracks expected. No evidence for a significant excess is found. Upper limits (90% c.l.) of the neutrino flux and luminosity of each source are given.

41792 **Proposal for the systematic naming of mesons and baryons.** Wohl, C.G.; Barnett, R.M.; Cahn, R.N.; Gidal, G.; Rittenberg, A.; Trippe, T.G.; Yost, G.P.; Porter, F.C. (Lawrence Berkeley Lab., Univ. of California, Berkeley, CA 94720 (US)). pp 192-197 of Proceedings of the Santa Fe meeting of the division of particles and fields of the American Physical Society. Goldman, T.; Nieto, M.M. Teaneck, NJ; World Scientific Pub. Co. (1985). (CONF-8410222—).

From American Physical Society meeting; Santa Fe, NM, USA (31 Oct 1984).

Twenty years ago, the Particle Data Group adopted a systematic naming convention for baryons: the symbols N, Δ, Λ, Σ, E, and Ω were to identify the isopin and strangeness. The mesons, by contrast, have become an alphabet soup of uninformative names - θ, iota, ξ, zeta, g/sub T/, g/sub s/, H, E, δ, h, g, r, κ, etc. -, and in some cases identical names are used for mesons with different quantum numbers (A, B, and D). Furthermore, experimentalists are now discovering baryons that contain heavy quarks. It is therefore timely to consider systematic naming contentions both for mesons and for baryons with heavy quarks. The Particle Data Group is circulating this proposal in the hope of generating feedback, and the authors attach a sheet for responses. It should be emphasized that the Particle Tables would show both the old and and new names for some time.

41793 **The zeta(8.3) as a mixture of eta/sub b/ with a pseudoscalar Higgs.** Clavelli, L.; Hendry, A.; Snyder, A. pp 278 of Proceedings of the Santa Fe meeting of the division of particles and fields of the American Physical Society. Goldman, T.; Nieto, M.M. Teaneck, NJ; World Scientific Pub. Co. (1985). (CONF-8410222—).

From American Physical Society meeting; Santa Fe, NM, USA (31 Oct 1984).

Recently a narrow state zeta(8.3) has been observed in the radiative decay of the Υ(9.46). The authors consider a model in which the zeta is a mixture of a pseudoscalar Higgs boson and a / sup 1/S/sub O/, bb-bar bound state. The evidence suggesting such an interpretation of the data is discussed and further implications are presented.

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REFER ALSO TO CITATION(S) 40809, 41676, 41723, 41792, 41858, 41865, 41913, 42051, 42063

41794 (BNL—52114, pp 117-144) New physics in high energy e^+e^- and hadron-hadron collisions. Ellis, J. (CERN, Geneva (Switzerland)). 1987. NTIS, PC A19/MF A01. Order Number DE88008012/JAW. (CONF-8710107—).

From Future perspectives in high energy physics; Upton, NY, USA (5 Oct 1987).

The physics capabilities of possible future e^+e^- and pp colliders are compared. For reasons of time, ep colliders will be discussed only briefly. How the physics reaches of e^+e^- and pp colliders vary is discussed as functions of the center-of-mass energy and luminosity.

41795 (BNL—52114, pp 145-154) Post-Fermi scale physics and future accelerators. Gershtein, S.S.; Pirogov, Yu.F. (Institute for High Energy Physics, Serpukhov (USSR)). 1987. NTIS, PC A19/MF A01. Order Number DE88008012/JAW. (CONF-8710107—).

From Future perspectives in high energy physics; Upton, NY, USA (5 Oct 1987).

New physics should necessarily manifest itself at the Fermi scale Λ/sub F/ ~ 0 (1 TeV). Investigations carried out at energies $\sqrt{s} \sim 0$ (1 TeV) will apparently be unable to solve a number of outstanding problems inherent in the Standard Model. The next scale of new phenomena (supernew physics) may be expected to lie in the (10^2-10^3) TeV energy range (the post-Fermi scale). It is necessary to examine more thoroughly the feasibilities of experiments in this energy range and of constructing the multi-TeV or PeV accelerators with the new technologies applied. Precision measurements carried out at lower energies, $\sqrt{s} \leqq 0$ (1 TeV), may help obtain additional indirect information on the objects and phenomena related to the larger scale. Low-energy facilities of new particles, (B, K,..), are an additional, to multi-TeV or PeV machines, tool for the study of super-new physics.

41796 (CEA-CONF—9296) Critical two dimensional statistical systems: conformal and modular invariance. Itzykson, C. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Service de Physique Theorique). 1987. 38p. (CONF-8706318—). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88753914/JAW.

From 1. Asia Pacific workshop on high energy physics, conformal field theories, anomalies and superstrings; Singapore, Singapore (29 Jun 1987).

We discuss some finite size effects at criticality, of conformal invariant two-dimensional field theories. The computation of the partition function in a finite geometry - a torus-enables one to understand the spectrum of the theory. The later is a compendium of the critical dimensions of the various operators. Two simple examples, namely bosonic or fermionic free fields (respectively the Gaussian and the Ising model) will serve as a pedagogic introduction. We then proceed to considerations related to modular invariance.

41797 (CEA-CONF—9312) Two dimensional critical models on a torus. Saleur, H.; Di Francesco, P. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Service de Physique Theorique). 1987. 28p. (CONF-8709300—). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88753925/JAW.

From Summer school on conformal invariance and strings theory; Poiana Brasov, Romania (1 Sep 1987).

After the general developments of conformal invariance in two dimensions, it was realized that the study of critical models in finite geometries, in addition to the practical information it could provide through finite size scaling, was also of great conceptual interest. The simplest example is the case of the torus, a genus 1 surface which is thus not conformally equivalent to the plane. This geometry appears quite frequently in lattice calculations for systems with periodic boundary conditions, and is also very natural from the point of view of string theory. We will discuss briefly in these notes the main results obtained so far in this simple case.

41798 (DOE/ER/40160—4) High energy hadron-hadron collisions: Annual progress report and research proposal. Chou, T.T. (Georgia Univ., Athens (USA). Dept. of Physics). Apr 1988. Contract FG09-84ER40160. 12p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88011904/JAW.

Results of a study on multiparticle emission in high energy collisons based on the geometrical models are summarized in a review article just published. More work is planned to further elucidate this model. Specific research problems on which we concentrate in the next year include multiplicity distribution and its impact parameter dependence, two-particle correlations in hadronic inelastic collisions, and particle productions in high energy nucleus-nucleus collisions.

41799 (DOE/ER/40214—2) [Research in theoretical particle physics]: Progress report for period January 1, 1987-December 21, 1987. McKay, D.; Munczek, H.; Melott, A.; Ralston, J. (Kansas Univ., Lawrence (USA). Dept. of Physics and Astronomy). 1987. Contract FG02-85ER40214. 13p. NTIS, PC A03/MF A01. Order Number DE88008230/JAW.

This paper briefly discusses topics in High Energy Physics. Some topics discussed are: symmetry breaking in weak interactions; chiral symmetry breaking; radiative decay of neutrinos; topology studies; generation-changing interactions; and charge asymmetry in production of a photon and a meson in e+ e/sup {minus/} annihilation.

41800 (DOE/ER/40427—01) [Nuclear theory]: [Annual report]. Miller, G.A. (Washington Univ., Seattle (USA). Dept. of Physics). 1987. Contract FG06-88ER40427. 13p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88012989/JAW.

This paper discusses the work completed at the University of Washington in neutrino physics, proton-proton and meson-meson scattering topics, astrophysics, and other related nuclear theory topics. (LSP)

41801 (EFI—934(85)-86) General solution of superconvergent sum rules for scattering of I=1 reggeons on baryons. Grigoryan, A.A.; Khachatryan, G.N. (Erevanskij Fizicheskij Inst. (USSR)). 1986. 42p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88701553/JAW.

Superconvergent sum rules for reggeon-particle scattering are applied to scattering of reggeons α/sub i/ (i=π, rho, A/sub 2/) with isospin I=1 on baryons with strangeness S=-1. The saturation scheme of these sum rules is determined on the basis of experimental data. Two series of baryon resonances with arbitrary isospins I and spins J=I+1/2 and J=I-1/2 are predicted. A general solution for vertices of interaction of these resonances with α/sub i/ is found. Predictions for coupling vertices B/sub α(sub i)/B′(B, B′=Λ, Σ, Σ/sup */) agree well with the experiment. It is shown that the condition of sum rules saturation by minimal number of resonances brings to saturation schemes resulting from experimental data. A general solution of sum rules for scattering of α/sub i/ reggeons on γ and Ω hyperons is analyzed. 27 refs.; 5 tabs.

41802 (EFI—948(99)-86) Analysis of reactions πp -> etaδ in quasi-eikonal model. Arakelyan, G.G.; Aslanyan, P.Zh.; Nazaryan, A.E.; Khachaturyan, M.N. (Erevanskij Fizicheskij Inst. (USSR)). 1986. 10p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88701558/JAW.

The work is devoted to analysis of experimental data on differential cross sections of reactions π/sup +/p -> etaΔ/sup ++/ and π/sup -/p -> etaΔ/sup 0/ within the framework of quasi-eikonal model. 10 refs.; 3 figs.

41803 (IAE—4473/2) Structure of weak interaction in the chiral bag model. Shmatikov, M.Zh. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1987. 12p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703141/JAW.

The structure of weak interaction between quarks and hadrons in the chiral bag model is considered. In the model there exists interaction of PI-mesons and quarks, which does not conserve the purity, and that results in the appearance of a weak qq-interaction with the exchange of PI-meson additional to the contact qq-interaction of the Weinberg-Salam electroweak theory. When P-odd PIqq-interaction is localized on the surface of the bag, the corresponding weak vertices PINN and PINΔ are reduced to zero. 14 refs.; 1 tab.

41804 **(IC—87/180) Simple theory of nonleptonic kaon decays.** Scadron, M.D.; Choudhury, S.R. (International Centre for Theoretical Physics, Trieste (Italy); Delhi Univ. (India). Dept. of Physics). (International Centre for Theoretical Physics, Trieste (Italy)). Jul 1987. 25p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703149/JAW.

We first summarize (a) why the quark s-bar-d-bar loop transition dominated by the physical W/sup +/ exchange controls the large $\Delta I=1/2$ K/sub π/ and K/sub 2π//sup o/ nonleptonic decay amplitudes, and (b) why the vacuum-saturated hadronic (implied W/sup +/) current-current hamiltonian correctly explains the small ΔI-3/2 K/sub 2π//sup +/ decay. Then we study in greater detail a more complete hadronic D.K.π meson-W/sup +-/ loop calculation of the $\Delta I=1/2$ and $\Delta I=3/2$ K/sub 2π/ amplitudes and show that this picture further reinforces our original quark $\Delta I=1/2$ and hadron vacuum-saturated $\Delta I=3/2$ (long distance) scheme. (author). 29 refs, 8 figs.

41805 **(IC—87/252) Simple unification.** Ponce, W.A.; Zepeda, A. (International Centre for Theoretical Physics, Trieste (Italy); Instituto Politecnico Nacional, Mexico City. Centro de Investigacion y de Estudios Avanzados). (International Centre for Theoretical Physics, Trieste (Italy)). Aug 1987. 17p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702968/JAW.

We present the results obtained from our systematic search of a simple Lie group that unifies weak and electromagnetic interactions in a single truly unified theory. We work with fractionally charged quarks, and allow for particles and antiparticles to belong to the same irreducible representation. We found that models based on SU(6), SU(7), SU(8) and SU(10) are viable candidates for simple unification. (author). 23 refs.

41806 **(IC—87/375) Role of current algebra in B->pp-bar$\pi(\pi)$.** Paver, N.; Riazuddin. (Trieste Univ. (Italy). Ist. di Fisica Teorica). (International Centre for Theoretical Physics, Trieste (Italy)). Nov 1987. 9p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702995/JAW.

We estimate in a current algebra framework the hadronic matrix elements relevant to the weak B->pp-bar$\pi(\pi)$ transitions measured recently. The results so obtained are in agreement with the observed values. (author). 11 refs, 1 fig.

41807 **(IC—87/406) Spectrometry of quark states in QCD and roots for effective lagrangians.** Andrianov, A.; Novozhilov, V.; Andrianov, V.; Novozhilov, Yu. (International Centre for Theoretical Physics, Trieste (Italy); Leningrad State Univ. (USSR). Dept. of Theoretical Physics). (International Centre for Theoretical Physics, Trieste (Italy)). Nov 1987. 15p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703008/JAW.

The mass-like asymmetry of quark spectrum in the gluon vacuum is investigated. The meaning of the spectral density for quark states is clarified and its connection with the gluon condensate is established. The concept of a non-perturbative low-energy region is applied to stabilize the low-energy fermion vacuum. The exact equation for the averaged quark spectrum is derived. It reveals the non-perturbative features of the dynamical quark mass. (author). 18 refs.

41808 **(IC—88/12) Relativistic quark model for strong processes.** Micu, L. (International Centre for Theoretical Physics, Trieste (Italy)). Jan 1988. 18p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703033/JAW.

A relativistic generalization of the pair creation model for strong decays is proposed. The model allows a unitary treatment of strong decays and particle production processes. Specific quark diagrams and their counting rules are given. (author). 9 refs, 2 figs.

41809 **(IC—88/25) Strangeness production in quark-gluon plasma.** Hoorani, H.R.; Siddique, K.A. (International Centre for Theoretical Physics, Trieste (Italy); Karachi Univ. (Pakistan). Dept. of Physics). (International Centre for Theoretical Physics, Trieste (Italy)). Jan 1988. 16p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703042/JAW.

In this paper it is shown that the strangeness production in quark-gluon plasma might not serve as an experimental signature for the formation of quark-gluon plasma. Our results are completely based on the computer simulation of the plasma. We have taken into account the full three-dimensional hydrodynamic expansion of the plasma. (author). 10 refs, 6 figs.

41810 **(IC—88/27) Production of J/psi in quark-gluon plasma.** Hoorani, H.R. (International Centre for Theoretical Physics, Trieste (Italy)). Feb 1988. 7p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88703043/JAW.

It was recently proposed by T. Matsui and H. Satz that J/psi suppression in nuclear collisions will provide an unambiguous signature for the formation of quark-gluon plasma. In this paper, we will discuss the present status of this proposal and make a few remarks about it. (author). 14 refs.

41811 **(IFVE-OTF—87-89) Weak-electromagnetic decays of neutral pseudoscalar mesons.** Komachenko, Yu.Ya.; Khlopov, M.Yu. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1987. 4p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88703196/JAW.

Submitted to the journal Phys. Lett. B.

Weak-electromagnetic decays of neutral pseudoscalar mesons P/sup 0/ -> $\nu\nu$-barγ(P/sup 0/=π/sup 0/, eta, eta') have been considered. The decay amplitude eta -> $\nu\nu$-barγ is shown to be sensitive to the degree of the SU/sub f/(3) symmetry breaking and that of eta' -> $\nu\nu'\gamma$ decay is, in principle, sensitive to the models with fractional and integer-charged quarks. 9 refs.

41812 **(ITEF—95(1987)) Cumulative particle production in the quark recombination model.** Gavrilov, V.B.; Leksin, G.A. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1987. 11p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703298/JAW.

Production of cumulative particles in hadron-nuclear inteactions at high energies is considered within the framework of recombination quark model. Predictions for inclusive cross sections of production of cumulative particles and different resonances containing quarks in s state are made. 17 refs.; 2 figs.

41813 **(ITEP—60(1987)) Multiple production of π/sup 0/- and eta-mesons in soft hadronic collisions.** Zoller, V.R. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1987. 10p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88703315/JAW.

Inclusive spectra of π/sup 0/- and eta-mesons are calculated in the framework of dual approach with topological pomeron. The results of recent experiment on multiple production of π's and eta's by π/sup -/-mesons at 360 GeV are discussed. 13 refs.; 3 figs.

41814 **(ITEP—101(1987)) Decays of orbitally excited hadrons.** Kobzarev, I.Yu.; Martem'yanov, B.V.; Shchepkin, M.G. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1987. 15p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703069/JAW.

In the QCD string model the two-particle decays of orbitally excited hadrons, caused by the creation of qq-bar pair in chromoelectric field of the string, are investigated. 10 refs.; 3 figs.

41815 **(ITEP—123(1987)) Four-quark states in potential model.** Badalyan, A.M.; Kitoroage, D.I. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1987. 28p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703070/JAW.

The mass spectrum of S-wave q/sup 2/q/sup -2/ mesons of u, d, s quarks is calculated in the framework of the nonrelativistic potential model and compared with the bag model predictions. The spin-spin splittings of almost all four-quark mesons with J/sup PC/ = 0/sup ++/, 2/sup ++/, 1/sup +-/ are shown to coincide with an accuracy of ~ 50 MeV in both approaches. Two exceptions are O/sup S/(9), C/sub π//sup S/(9) mesons for which the discrepancy is ~ 300 MeV. Calculated centers of gravity of the multiplets are systematically ~ 120 MeV higher than the MIT bag predictions. 14 refs.; 4 tabs.

41816 **(ITEP—135(1987)) Orbital excitation of hadrons with heavy quarks.** Kondratyuk, L.A.; Martem'yanov, B.V.; Shchepkin, M.G. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1987. 12p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703071/JAW.

The study on the spectroscopy of hadrons with high spins on the basis of QCD string model with spin-orbit interaction are considered. The orbital excitations of mesons and baryons which contain one heavy quark (c or b) are analyzed. Predicting the masses of particle on leading Regge trajectories (D*-, B*-, Λ/sub c/- and Λ/sub b/-excitations) are also considered by the spin dependent interactions between quarks. The main influence of spin effects on spectra is related to the fact that the orientation of spin along the orbital momentum is energetically preferable. From the point of view of potential approach this means the dominant role of the spin effects corresponding to the Lorentz scalar interaction which gives long-range spin-orbit coupling. For lowest orbital excitations there may also be some contributions from short-range (Vector-like), as well as spin-spin and tensor couplings. Those corrections are also dependent in different way on quark masses. 13 refs.; 2 figs.

41817 **(ITEP—196(1986)) Effects of six-quark bags on the /sup 1/D/sub 2/ NN partial wave and the question of dibaryon resonances.** Grach, I.L.; Kalashnikova, Yu.S.; Narodetskij, I.M. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1986. 12p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88701650/JAW.

The coupled /sup 1/D/sub 2/(pp)-/sup 5/S/sub 0/(ΔN) channels are studied in a relativized version of the quark compound bag (QCB) model. The QCB model is a semiphenomenological model that incorporates the important role that the bag dynamics plays at small distances. In this model, the short-range hadron force is given by the energy-dependent and non-local potential and contains few parameters which are defined by the wave function of the six-quark primitive. It is suggested that this force is responsible for the appearance of the S-matrix pole of the dibaryon amplitude. The QCD short-range force is shown to reproduce an energy dependence of the /sup 1/D/sub 2/ phase shift and inelasticity in the region T >or approx. 200 MeV. At small energy the effect of the long-range meson force is essential. The values of the QCD parameters found from the fit to the data are in good agreement with theoretical predictions for the MIT bag model. 17 refs.; 2 figs.; 1 tab.

41818 **(ITF—87-48) Contemporary high-energy data: which froissarton do they prefer?.** Glushko, N.I.; Kobylinskij, N.A. (AN Ukrainskoj SSR, Kiev. Inst. Teoreticheskoj Fiziki). 1987. 21p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703323/JAW.

Up-to-date data on pp and p-barp interactions are analyzed on the basis of two well-known representations which transmute the supercritical pomeron into a froissaron. Both approaches are found to be equivalent from the phenomenological point of view, and the impact amplitudes tend asymptotically in both cases to the values close to those values obtained in the scattering model on a black disk. The impact amplitudes are restored and the way in which the black spot is formed with the energy is studied. 15 refs.; 15 figs.

41819 **(ITP—87-19) Effective action for composite operators and chiral symmetry breakdown in asymptotically free and non-asymptotically free gauge theories.** Gusynin, V.P.; Miranskij, V.A. (AN Ukrainskoj SSR, Kiev. Inst. Teoreticheskoj Fiziki). 1987. 25p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703327/JAW.

An essential distinction in the relaization of the PCAC dynamics in asymptotically free and non-asymptotically free (with a non-trivial ultraviolet-stable fixed point) gauge theories is revealed. For the latter theories an analytical expressions for the condensate <PHI-barPHI> is obtained in the two-loop approximation and arguments of support of a soft behaviour at small distances of composite operators are given. The problem of factorizing the low-energy region for the Wess-Zumino-Witten action is discussed. Besides, the mass relations for pseudoscalar mesons in arbitrary Θ-sector are obtained in the first order in fermion bare masses and the impossibility for spontaneous P and CP-symmetries breaking in vector-like gauge theories at Θ=0 is shown. 20 refs.

41820 **(JINR—E-2-87-300) Nonleptonic decays of charmed mesons D->0/sup -/0/sup -/ and mixing angles in SU(4).** Kalinovskij, Yu.L.; Kallies, W.; Pervushin, V.N.; Sarikov, N.A. (Gomel'skij Politekhnicheskij Inst. (Byelorussian SSR); Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics; AN Uzbekskoj SSR, Tashkent. Inst. Yadernoj Fiziki). (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1987. 7p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88703073/JAW.

Submitted to the International Europhysics Conference on High Energy Physics, Uppsala (Sweden), 25.06.87 - 01.07.87 and to Sov. J. Nucl. Phys. .

The Cabbibbo-suppressed charmed meson decays D -> O/sup -/O/sup -/ are considered in the framework of the chiral Lagrangian method with broken SU(4)xSU(4). To break the symmetry, the scheme of Oakes is extended to SU(4) by taking into account an additional rotation around the 10th axis in the SU(4) space. For the rotation angles Θ/sub 7/ and Θ/sub 10/ the following values: sinΘ/sub 7/=0.27, sinΘ/sub 10/=0.05 are obtained. For the ratio Γ(D/sup 0/ -> K/sup +/K/sup -/)/Γ(D/sup 0/ -> π/sup +/π/sup -/) an additional rotation leads to the values 1.2 instead of 0.75 when Θ/sub 10/=0. The results are compared to the available data on the D -> O/sup -/O/sup -/ decays. 20 refs.; 1 tab.

41821 **(JINR-D—2-87-314) Double recharge of pions on a deuterium.** Nichitiu, F.; Falomkin, I.V.; Shcherbakov, Yu.A. (Institutul de Fizica si Inginerie Nucleara, Bucharest (Romania)). (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1987. 6p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88703340/JAW.

Submitted to the Organizing Comittee of 5. All-union seminar on Program of experimental investigations at meson factory of Institute of Nuclear Research of Academy of Sciences of USSR, Zvenigorod, 11 - 15 Apr 1987.

Assumptions on the dibaryon nature of the existing narrow resonances below the threshold of the NΔ-state with masses 1935, 1965, 2015 MeV are considered. New proposals on construction of the particle systematics with a new particle (R-particle of mass

1025 MeV, J=1/2, T=3/2) are used to draw a conclusion that double charge exchange is possible on deuterium and helium-3 if dibaryons or new R-particles are born in the final state. Attention is paid to a possible decay of these particles through a weak channel. A search for double charge exchange of pions on hydrogen and deuterium using a laser-illuminated streamer chamber of high pressure is proposed. 11 refs.; 2 figs.

41822 **(JINR-E—2-87-270) Phenomenology and theory of confinement.** Pervushin, V.N. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1987. 12p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703346/JAW.

Submitted to the International conference on high energy physics, Sweden, 1987.

Phenomenological and theoretical arguments of the separation of the hadronization dynamics from confinement and the idea of the "kinematic" confinement are discussed. The recent theory contains results which point out that the Wilson criterion and the confinement potentials are not sufficient for explaining the phenomenological confinement in the sense of zero color amplitudes or Green functions. However, these potentials well explain the hadron spectrum and spontaneous breaking of chiral symmetry, i.e., the hadronization dynamics. The "kinematic" confinement can be explained by the topological degeneration of all color-particle physical states in QCD. This degeneration arises if the theory is quantized by explicitly solving the gauge and dynamic constraints: all color states are defined up to gauge(phase) factors describing the map of the three-dimensional space onto SU(3)/sub c/-group (π/sub 3/(SU(3)/sub c/=Z). The total probability of the color particle generation is equal to zero due to the destructive interference of these phase factors. As a result, in QCD there remains only a hadron sector used in the phenomenology. 25 refs.

41823 **(JINR-E—2-87-484) Accurate multiplicity scaling.** Golokhvastov, A.I. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1987. 8p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88703348/JAW.

Submitted to the journal Phys. Lett., B.

The commonly used formula of KNO scaling <n>P/sub n/=phi(n/<n>) at finite multiplicity <n> is shown to contradict the normalization condition ΣP/sub n/=1. A consistent generalization of the concept of similarity for multiplicity distribution is presented. Analysis of the experimental data on pp and e/sup +/e/sup -/ interactions shows that the multiplicity distributions of negative particles are similar over the whole experimentally studied energy range. 14 refs.; 8 figs.

41824 **(JINR-E—2-87-557) On the problem of production of relativistic lepton bound states in the decays of light mesons.** Kozlov, G.A. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1987. 12p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703350/JAW.

Submitted to the journal Sov. J. Nucl. Phys. .

The probabilities for the production of lepton-antilepton bound orthostates in the decays of light pseudoscalar mesons are calculated in the model allowing for the mass of consistuent quarks. The relativistic wave function of a lepton bound state is used in the calculations. The results are compared with the experimental data. 13 refs.; 1 fig.

41825 **(JINR-E—2-87-646) New sum rules for polarized deep inelastic scattering.** Efremov, A.V.; Teryaev, O.V. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics; IGM, AS USSR, Dnepropetrovsk). (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1987. 6p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88703351/JAW.

Submitted to the journal Phys. Lett. .

Relations between structure functions g/sub 1/ and g/sub 2/ of polarized deep inelastic scattering are derived in the leading perturbative QCD approximation starting with the sum rules for twist 3 parton correlation functions following from gauge invariance and the equation of motion of quark fields. For the first moments they coincide with the approximate relations proposed earlier by Wandzura and Wilczek as well as Bukhvostov, Kuraev, Lipatov. 14 refs.

41826 **(JINR-E—2-87-664) Some integrals for analytic bremsstrahlung calculation. Photon and Z/sup 0/-boson exchange in the ultrarelativistic limit.** Bardin, D.Yu.; Riemann, T.; Fedorenko, O.M. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics; Petrozavodskij Gosudarstvennyj Univ. (USSR)). (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1987. 16p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703353/JAW.

An exhaustive list of integrals is presented which has been used together with the system of analytic calculations SCHOONSCHIP to obtain observable inclusive in the photon degrees of freedom for the processes e/sup +/e/sup -/ -> γ, Z/sup 0/ -> f-barf(γ), V -> f-bar/sub 1/f/sub 2/(γ), V = W/sup +-/, Z/sup 0/. The extreme relativistic approximation over fermion masses (m/sub f//sup 2/ << s) is used. The Tables presented are of general interest for calculations of bremsstrahlung contributions in QED, QCD and electroweak processes. 10 refs.

41827 **(JINR-E—2-87-675) Systematic iterative approach to the equations of low type.** Znojil, M. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1987. 12p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703354/JAW.

Nonlinear singular integral equations of the Low type appear in the description of π-N scattering amplitude at relativistic energies. The standard iteration solution differs and does not give sufficiently exact results even using the Pade approximation. A new approach is proposed. Its essence lies in a repeated formal simplification of the equation accompanied by a representation of the simplified amplitude in a generalized continued-fractional form. A simple example demonstrate that the new method improves the convergence of previous approach and essentially expands the region of its convergence. From the other side, its nonequivalence to a more complicate Newton-Kantorovich method is shown. In the future more realistic applications of the method one can expect increasing of result reliability. 8 refs.; 2 tabs.

41828 **(JINR-E—2-87-711) Gluon bremsstrahlung K-factors in N=1 SUSY QCD.** Darbaidze, Ya.Z.; Merebashvili, Z.V.; Slepchenko, L.A.; Matveev, V.A. (Tbilisskij Gosudarstvennyj Univ. (USSR)). (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1987. 10p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88703355/JAW.

Submitted to the journal Phys. Lett. .

K-factor for the qq-bar -> PHIPHI-bar process in N01 SUSY QCD is calculated. The exact gluon bremmstrahlung matrix elements squared allowing for computation of the corresponding K-factors are obtained. As an illustration the cross sections for the processes qq -> PHIPHIG are presented. 12 refs.; 3 figs.; 2 tabs.

41829 **(JINR-E—2-87-780) How to satisfy the energy-momentum conservation law and to take into account the Fermi motion of the constituents in simulation of composite system interactions.** Shmakov, S.Yu.; Uzhinskij, V.V. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Computing Techniques and Automation). 1987. 3p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88703359/JAW.

Submitted to the journal Sov. J. Nucl. Phys. .

A method which allows taking into account the Fermi motion of nuclear nucleons at Monte Carlo simulation of exclusive states in hadron-nucleus and nucleus-nucleus interactions is suggested. In the case of hadron-hadron interactions the method allows taking into account quark transverse momenta and ensuring energy-momentum conservation. 7 refs.

41830 (JINR-R—2-87-217) K-meson form factor at small Q/sup 2/. Bejlin, V.A.; Nesterenko, V.A.; Radyushkin, A.V. (Rostovskij-na-Donu Gosudarstvennyj Univ. (USSR); Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1987. 15p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703385/JAW.

Submitted to the journal Int. J. Modern Phys. .

Within the QCD sum rule the electromagnetic charge radii of K/sup +-/- and K/sup 0/-mesons are calculated. The results are in good agreement with experiment. Calculation method and its relation with the vector dominance model. 34 refs.; 5 figs.

41831 (JINR-R—2-87-251) Mass spectrum of vector and pseudoscalar mesons in relativistic quark model. Galkin, V.O.; Faustov, R.N. (Moskovskij Gosudarstvennyj Univ. (USSR); Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1987. 10p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88703386/JAW.

On the basis of the quasipotential method of describing the relativistic bound states, the mass spectrum of vector and pseudoscalar mesons is analysed. The found theoretical expressions are in good agreement with the experimental data for heavy as well as for light mesons. 11 refs.; 2 tabs.

41832 (JINR-R—2-87-347) Quarkonium inverse problem with complete account of spin dependence in the relativistic Todorov equation. Aleksandrov, L.; Drenska, M.; Karadzhov, D.; Morozov, P. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1987. 16p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703388/JAW.

The quarkonium inverse problem based on the quasipotential approach of Todorov with exact account of the spin-dependent interactions is solved. As a result, potential parameters and quark masses in chromium and bottomium systems are obtained for the complete experimentally observed spectra of these systems. The quasipotentials are constructed from the model generating potentials: the conventional (including Coulomb and linear term) potential and the Richardson potential. Results obtained by the spin inverse problem are compared with the results corresponding to a relativistic spinless variant and the results based on to Schroedinger equation. 15 refs.; 4 tabs.

41833 (JINR-R—2-87-384) Nucleon quark structure and strong meson-nucleon form factors. Efimov, G.V.; Ivanov, M.A.; Lyubovitskij, V.E. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics; Tomskij Gosudarstvennyj Univ. (USSR)). (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1987. 22p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703389/JAW.

Submitted to the journal Sov. J. Nucl. Phys. .

The nucleon is considered as a three-quark system in virton-quark model. The main statistic properties of proton and neutron are calculated: magnetic moments, electromagnetic radii, G/sub A//G/sub V/ ratio in weak neutron decay. Strong meson-nucleon form factors which determine nucleon-nucleon potential are obtained as a function of squared transfer momentum of mesons. The results are compared with phenomenological form factors used for description of phases of NN-scattering in the one-boson-, exchange model. 32 refs.; 7 figs.; 2 tabs.

41834 (JINR-R—2-87-510) On fluctuations of cross sections of dibaryon resonances. Bazhanskij, I.I.; Reznik, B.L.; Luk'yanov, V.K.; Titov, A.I. (Dal'nevostochnyj Gosudarstvennyj Univ., Vladivostok (USSR)). (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1987. 4p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88703077/JAW.

Submitted to the journal Phys. Lett. .

It is shown that narrow peaks observed in the effective mass spectra of the np- and pp-systems, in np -> ppπ/sup -/ and dp -> ppn reactions could be interpreted as fluctuations of cross sections originating from overlapping of a large number of dibaryon resonances. The investigations has been made on the basis of analysis of distributions and energy correlation functions of cross sections of dibaryon resonance production. 6 refs.; 1 fig.

41835 (JINR-R—2-87-532) Relativistic form factor in terms of wave functions of composite systems at rest. Kvinikhidze, A.N.; Magradze, B.A.; Khvedelidze, A.M. (AN Gruzinskoj SSR, Tbilisskij Matematicheskij Inst.). (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1987. 10p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88703395/JAW.

Submitted to the journal Theor. Math. Phys. .

A formalism based on the expansion of the boost operator over the coupling constant degrees is verified by the description of the relativistic form factor in terms of the wave functions of composite particles at rest. Calculation in the second perturbation order in QCD indicates a monopole decrease of a meson form factor at large transfer momentum. 4 refs.; 1 fig.

41836 (JINR-R—4-87-235) Multipole representation of rho meson in pion form factor. Bykovskij, B.V.; Meshcheryakov, V.A. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1987. 15p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703078/JAW.

Submitted to the journal Sov. J. Nucl. Phys. .

The problem of description of resonances by means of pole terms is analysed. It is shown that in the case of electromagnetic pion form factor, taking account of the structure of Riemann surface of the amplitude of $\pi\pi$ interaction leads to the increase of the number of poles as compared with vector dominance model. The model takes the inelastic region of the $\pi\pi$-amplitude effectively into account and permits one to describe the bahaviour of the pion form factor satisfactorily in a wide energy interval. 11 refs.; 6 figs.

41837 (KEK—87-20, pp 1-5) Indirect searches for heavy quarks in rare decays. Wakaizumi, Seiichi. (Hiroshima Univ. (Japan). Dept. of Physics). Nov 1987. NTIS (US Sales Only), PC A12/MF A01. Order Number DE88780084/JAW. (CONF-8705290—).

From Meeting on physics at TeV energy scale; Oho, Japan (28 May 1987).

Investigation is made of the effects of ultra-heavy quarks (top and fourth generation) via one-loop diagrams on the rare decays of K/sup +/->π/sup +/$\nu\nu$-bar, Z/sup 0/->qq-bar'+q'q-bar(qnot =q'), B/sup 0/-B-bar/sup 0/ mixing and CP violation in B decays. This is one of the powerful methods to discover and study the properties of new quarks, as its validity was historically shown in the indirect discovery of the charm quark via K/sub L/->$\mu\mu$-bar. The present study is particularly focused on the effects of heavy top quark in the range of 40 - 160 GeV and/or fourth generation up quark of around 200 GeV. As for the quark mixing matrix, the study adopts the Wolfenstein parametrization with the expansion of its matrix elements by the Cabbibo angle, since in this parametrization, various hierarchical schemes can be assumed for the mixing of the fourth generation with first three generations. The rare decays are studied for the following two cases (Case A and Case B): chemical bondV(b't', bt', st', dt'chemical bond ~ (1, λ, λ/sup 2/, λ/sup 3/) and ~ (1, λ, λ/sup 2/, λ/sup 3/). First, the branching ratio for K/sup +/->π/sup +/$\nu\nu$-bar and Z/sup 0/->qq-bar'+q'q-bar(qnot =q') is discussed in relation to the 3- and 4-generation models. Then the mass splitting of mass eigenstates due to B/sup 0/-B-bar/sup 0/ mixing is examined. Discussion is also made of CP asymmetries in the non-leptonic B/sup 0/ decays. (Nogami, K.).

41838 (KEK—87-20, pp 131-147) Phenomenology in composite models. A review of composite weak bosons. Akama, Keiichi. (Saitama Medical School, Moroyama (Japan)). Nov 1987. NTIS (US Sales Only), PC A12/MF A01. Order Number DE88780084/JAW. (CONF-8705290—).

From Meeting on physics at TeV energy scale; Oho, Japan (28 May 1987).

The present report reviews theories and phenomenologies of composite weak bosons. Since it was known that the standard gauge model well explained the experimental results at low energies, people first considered the weak bosons as composite gauge bosons. Some people identified them with the composite gauge bosons associated with the hidden local symmetry. From more dynamical point of view, Terazawa considered the penetration of gauge symmetry from the sublevel to the composite level. The current mixing scheme with non-gauge weak bosons can also explain the low energy phenomena. How do the composite weak bosons reveal their compositeness? People considered current algebra, vector-boson dominance, Regge poles, duality, etc. What are the dynamical forces which bind subconstituents into the weak bosons? In the strongly coupled standard model, the SU(2)/sub L/ gauge force itself bind the subconstituents. Some people used approximate methods such as the subconstituent-loop diagram, non-relativistic models, etc., to obtain dynamical predictions. From more phenomenological point of view, many works derived limits from the low energy experiments, and estimated rates of productions and decays of the composite weak bosons, and those of the resonances. (Nogami, K.) 97 refs.

41839 (KFKI—1988-04/A) Restoration of 2-π/sup 0/ inclusive distribution from observed 2-γ data. Diosi, L.; Lukacs, B. (Hungarian Academy of Sciences, Budapest. Central Research Inst. for Physics). Feb 1988. 14p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703436/JAW.

A formula is derived to restore the 2-π/sup 0/ effective mass distribution from the observed 2-γ distribution. The method is applied on bubble chamber events of moderate statistics as a preliminary survey, and gives an exponential asymptotics in the relative rapidity. (author) 8 refs.; 2 figs.

41840 (LAPP-TH—203-87) Role of locality in string quantization. Stora, R. (Grenoble-1 Univ., 74 - Annecy (France). Lab. de Physique des Particules). Oct 1987. 12p. (CONF-8707177—). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88753971/JAW.

From Cargese summer study institute on non perturbative quantum field theory; Cargese, France (16 Jul 1987).

We shall mostly be concerned with the one orbit theory in the conformal gauge, i.e. assume no global zero mode. In this framework, we describe the Slavnov symmetry and the corresponding Slavnov identity, the covariance under diffeomorphisms, and the corresponding ward identity, the localized Slavnov symmetry and the corresponding current algebra. Locality is used throughout and provides unambiguous answers, e.g. on the existence and form of the anomalies. In general, however, the conformal gauge is not a good gauge. In the present framework, this is signalled by the presence of global zero modes which depend on the boundary conditions and have to be gauge fixed. As an example, the case where the world sheet is a compact Riemann surface of genus $g > 1$ is treated in some details.

41841 (LAPP-TH—204-87) Superstrings and cosmology. Binetruy, P. (Grenoble-1 Univ., 74 - Annecy (France). Lab. de Physique des Particules). 1987. 8p. (CONF-8707174—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88753880/JAW.

From Rencontre on the hidden mass and the dark matter; Annecy, France (8 Jul 1987).

Some of the most specific features of the cosmology of strings and superstring-inspired models are reviewed. The possibility that the lightest supersymmetric partner be unstable is stressed.

41842 (LPC—86-08) Probing the pomeron structure with quasi-real photons. Arteaga-Romero, N.; Kessler, P.; Silva, J. (College de France, 75 - Paris. Lab. de Physique Corpusculaire). Mar 1986. 6p. (CONF-8604238—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88753972/JAW.

From 7. international workshop on photon-photon collisions; Paris, France (1 Apr 1986).

Following a recent suggestion of Ingelman and Schlein, we here consider the possibility of probing the gluonic structure of the pomeron with quasi-real photons, i.e. in reactions e p -> e p + 2 jets + X taking place at an ep collider such as HERA.

41843 (NBI-HE—87-61) Theoretical perspective. Nielsen, H.B. (Niels Bohr Inst., Copenhagen (Denmark)). Sep 1987. 18p. (CONF-8703136—). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88752699/JAW.

From Elementary structure of materials; Les Houches, France (24 Mar 1987).

We have a theory, QCD. It is, however, extremely difficult to make use of this theory in practice (in this energy regime). Therefore, typically one replaces QCD by a more applicable model which approximates QCD in the low energy regime. Different intermediate models approximating QCD may be used under different conditions, in say, the cold hadron and in the hot quark-gluon plasma phases.

41844 (NBI-HE—87-84) Inequality relating gauge group coupling constants and the number of generations in a string inspired model. Nielsen, H.B.; Bennett, D.L.; Picek, I. (Niels Bohr Inst., Copenhagen (Denmark); Niels Bohr Inst., Copenhagen (Denmark); Institut Rudjer Boskovic, Zagreb (Yugoslavia)). Dec 1987. 22p. (CONF-8707180—). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88754032/JAW.

From Workshop on string theories; Beijing, China (6 Jul 1987).

Using a model with a regularized (e.g. latticized) Kaluza-Klein space-time at the fundamental scale with Yang-Mills fields in the compactified dimensions, we examine the β-function for a dimensionless expression for the coupling constants g in D-dimensions. In going from the Planck scale of $D > 4$ down in energy to the scale where D goes from $D > 4$ to $D = 4$, it is argued that couplings are weakened by a factor roughly equal to the number of fundamental string regions that can be accommadated in the volume of the compactification space. Subsequently this factor is claimed to be greater than the number of generations by using an argument reminiscent of that often encountered in string model T.O.E. in which various quark and lepton generations are said to correspond to various zero modes of a Weyl operator in the compactifying space. Finally, it is argued that the inequality, which can be shown to be more saturated the larger the gauge group, is already near saturation for the group factors of the SMG. This fact leads to several conclusions: 1. there is not room for many more than 3 generations; 2. G.U.T. can be accommadated only at scales very close to the fundamental scale; 3. No new blossoms are expected to be found in the desert; 4. the compactifying space should not be 'larger than necessary'; 5. at the fundamental scale, couplings are expected to be close to (but not suspiciously close to) β/sub crit./. (orig./HSI).

41845 (UWThPh—1988-1) Basic transformations in generation space and a criterion for the existence of standard forms for unitarily congruent matrices. Grimus, W.; Ecker, G. (Vienna Univ. (Austria). Inst. fuer Theoretische Physik). 1988. 12p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703478/JAW.

Basic transformations for fermion generations lead to a consideration of matrix transformations of the type U/sup T/AU with unitary U. It is shown that A can be brought to a certain standard form iff A and A/sup T/ are simultaneously diagonalizable by a biunitary transformation. Application of this theorem allows for a standardization of Yukawa couplings. 9 refs.

41846 (UWThPh—1988-3) T violation in neutralino decay. Oshimo, Noriyuki. (Vienna Univ. (Austria). Inst. fuer Theoretische Physik). 1988. 21p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703479/JAW.

We show that in the supersymmetric standard electroweak theory the neutralino decay causes CP violating phenomena. It will be possible to observe T odd asymmetry in the angular distribution if the trilepton decay of the W boson is found. We also discuss the constraint on the magnitude of CP violation by the electric dipole moment of the neutron. 10 refs., 9 figs.

41847 (UWThPh—1988-9) T odd asymmetry in trileptonic decay of scalar lepton. Oshimo, Noriyuki. (Vienna Univ. (Austria). Inst. fuer Theoretische Physik). 1988. 15p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703483/JAW.

The complex mass matrix for neutralinos could lead to T violation in the neutralino decay. We analyze the successive decay of the scalar lepton into three leptons and the lightest neutralino, which is mediated by a heavier neutralino. If the magnitude of CP violation is not small, T odd asymmetry will be observed in the angular distribution of the three leptons. 6 refs., 6 figs.

41848 D-wave quarkonium levels of the Y family. Kwong, W.; Rosner, J.L. (Enrico Fermi Institute and Department of Physics, University of Chicago, Chicago, Illinois 60637). *Physical Review [Section] D: Particles and Fields;* 38: No. 1, 279-297(1 Jul 1988).

A key test of the nonrelativistic potential description of quarkonium is the confirmation of predicted D-wave levels. For the bb-bar system (Y family), the lowest spin-triplet levels ($1\ ^3D$) are expected to lie in the range 10 157 +- 10 MeV/c^2 and the next set of levels is expected in the range 10 441 +- 10 MeV/c^2. Predictions are made for electric dipole transitions involving these levels, and specific suggestions are made for their observation. The most favorable decay chain appears to be $Y(3S)\rightarrow\gamma_1+2P\rightarrow\gamma_1+\gamma_2+1D\rightarrow\gamma_1+\gamma_2+\gamma_3+1P$, where γ_1 and γ_3 have energies of about 100 MeV and E/sub γ//sub =/≅250 MeV. Angular distributions of these photons are discussed.

41849 Modeling polarization asymmetry. DeGrand, T.A. (Physics Department, University of Colorado, Boulder, Colorado 80309). *Physical Review [Section] D: Particles and Fields;* 38: No. 1, 403-404(1 Jul 1988).

I comment on the relation of the calculation of Fujita and Matsuyama to the polarization-asymmetry model of DeGrand and Miettinen.

41850 Double Higgs from w-w fusion. Keung, W.Y. (Dept. of Physics, Univ. of Illinois-Chicago, IL 60680 (US)). *Modern Physics Letters A;* 2: No. 10, 765-770(Oct 1987).

The authors study the double Higgs boson production in pp collider at SSC energy via W-W fusion. The calculation are based on the exact CALKUL method. They also checked the result with the equivalent W/sub L/W/sub L/ approximation.

41851 A possible solution to the E/iota puzzle. Caldwell, D.O. (Physics Dept., Univ. of California, Santa Barbara, CA 93106 (US)). *Modern Physics Letters A;* 2: No. 10, 771-776(Oct 1987).

Apparent experimental conflict in the 1.4 GeV mass region for non-strange mesons can be resolved if there are three states: the 1.45 GeV iota, which is mainly gluonium; a 1.42 GeV 0/sup -/ predominantly ss-bar state, probably the missing eta' in the radially excited nonet; and a 1.42 GeV 1/sup +/ mainly light quark state, which does not fit in the 1/sup ++/ nonet. The third of these appears to a be a possible candidate for a four-quark meson.

41852 Heavy-quark systems. Kwong, W.; Rosner, J.L. (Enrico Fermi Institute and Dept. of Physics, Univ. of Chicago, Chicago, IL 60637 (US)). pp 325-382 of Annual review of nuclear and particle science, Volume 37. Jackson, J.D. Palo Alto, CA; Annual Reviews Inc. (1987).

The authors begin in Section 2 with a brief review of what is known experimentally about particles containing heavy quarks. They turn in Section 3 to the theoretical underpinnings of the spectroscopies of these particles. The J/psi family and other hadrons containing the charmed quark occupy Section 4. Section 5 is devoted to the spectroscopy of hadrons containing the b quark, and Section 6 to a comparison of the γ and charmonium families. The still-to-be discovered top quark and the spectroscopy of its bound states are treated in Section 7. The spectroscopic methods that have been so successful for charmonium and the γ family can be applied to the bound states of new strongly interacting constituents, such as quarks beyond the anticipated t, or spinless colored objects. Some methods for dealing with these exotic possibilities are discussed in Section 8. Conclusions are drawn in Section 9. The length of the present article requires that the authors cover the topic selectively; some aspects are mentioned only briefly and others not at all.

6453 Particle Invariance Principles And Symmetries

REFER ALSO TO CITATION(S) 41921, 41922, 42156, 42170

41853 (NBI-HE—88-08) Covariant quantum description of the N=2 Brink-Schwarz superparticle. Frolov, S.A.; Slavnov, A.A. (Steklov (V.A.) Inst. of Mathematics, Moscow (USSR)). (Niels Bohr Inst., Copenhagen (Denmark)). Feb 1988. 11p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88754033/JAW.

Covariant quantum effective action for the N=2 Brink-Schwarz superparticle is constructed starting from the canonical formulation in the light-cone gauge. BRST quantization is discussed.

41854 New heavy lepton pair-production from Z' resonances at hadron colliders. Hewett, J.L.; Rizzo, T.G. (Ames Lab. and Dept. of Physics, Iowa State Univ., Ames, IA (US)). *Modern Physics Letters B;* 3: No. 6, 589-598(May 1988).

The authors examine the possibility that heavy lepton (L) pair production can be significantly enhanced by the existence of a new neutral gauge boson Z' in hadron collisions. The authors find that in several E/sub 6/-type models, the LL-bar production cross section far exceeds that expected in the standard model. This may allow for the observation of LL-bar pairs above the large W/sup +/W/sup -/ background.

41855 Some remarks concerning the finiteness of N = 4 supersymmetric Yang Mills theories. Bassetto, A.; Dalbosco, M. (Dipartimento di Fisica "G. Galilei" -Universita di Padova Istituto Nazionale di Fisica Nucleare - Sezione di Padova (IT)). *Modern Physics Letters A;* 3: No. 1, 65-70(Jan 1988).

The authors carefully discuss the finiteness of SUSY YM N=4 in the light cone gauge, first at the one loop level by directly exhibiting the relevant terms of the lowest order Green functions and then at any loop order by using a recent treatment of the renormalization of general Yang-Mills theories in the light cone gauge. They point out the existence of a set of divergent Green functions which however do not contribute to observable quantities, thereby recovering consistency with formulations in other gauges.

41856 The search for lepton-family-number nonconservation. Hoffman, C.M. (Los Alamos National Lab., Los Alamos, NM (US)). pp 315-340 of Proceedings of the seventh workshop on grand unification/ICOBAN '86. Arafune, J. Teaneck, NJ; World Scientific Pub. Co. (1987). (CONF-8604202—).

From 7. workshop on grand unification; Toyama City, Japan (16 Apr 1986).

A review of the status of lepton-family-number nonconservation is given. After a brief historical and theoretical discussion, a description of how experimental searches for lepton-family-number nonconservation are performed is presented. Finally, a summary of the results from past experiments and prospects for future experiments is given.

41857 A calculation of atmospheric neutrino-induced backgrounds in the IMB detector. Bionta, R.M.; Casper, D.; Dye, S.; Errede, S.; Foster, G.W.; Haines, T.J.; Jones, T.W.; Kropp, W.R.; Price, L.; Svoboda, R. (Univ. of California, Irvine, CA (US)). pp 42-57 of Proceedings of the seventh workshop on grand unification/ICOBAN '86. Arafune, J. Teaneck, NJ; World Scientific Pub. Co. (1987). (CONF-8604202—).

From 7. workshop on grand unification; Toyama City, Japan (16 Apr 1986).

The authors developed a model of atmospheric ν interactions which provide the backgrounds to nucleon decay experi-

ments. They report results from a 417 live-day exposure of the IMB detector. During this time 401 contained events were observed at a rate and with characteristics consistent with atmospheric ν interactions. The authors calculated the expected backgrounds to a variety of two- and three-body decay modes and have set background subtracted lower limits of many nucleon partial lifetimes.

6454 Field Theory

REFER ALSO TO CITATION(S) 41663, 41796, 41807, 41819, 41855

41858 (CEA-CONF—9298) A-D-E classification of conformal invariant field theories in two dimensions. Cappelli, A. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Service de Physique Theorique). 1987. 15p. (CONF-8708261—). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88753915/JAW.

From Summer school of non perturbative quantum field theory; Cargese, France (3 Aug 1987).

We review the construction of the partition function on a torus for conformal invariant theories. For central charge lower than one, the condition of modular invariance on a torus determines the fields appearing in the theory. These sets of fields are in one-to-one correspondance with Lie algebras of type A, D and E. Some theories with extended symmetry are similarly classified.

41859 (CONF-8709225—6) Three tricks for simulating the scalar sector of the Weinberg--Salam model. Neuberger, H. (Rutgers--the State Univ., Piscataway, NJ (USA). Dept. of Physics and Astronomy). 1987. Contract FG05-86ER40265. 5p. (RU—48-87). NTIS, PC A02;3. Order Number DE88011181/JAW.

From International symposium on field theory on the lattice; Seillac, France (28 Sep 1987).

The following topics are discussed: F_4 lattices and their importance for the simulation of heavy Higgs systems, a soft-pion-finite size theorem and the measurements of f/sub pi/ and Adler's Overrelaxation Algorithm and critical slowing down. Several general comments are also given. 10 refs.

41860 (DOE/ER/40371—T1) [Intermediate/high energy nuclear physics]. (Iowa State Univ. of Science and Technology, Ames (USA). Dept. of Physics). 1987. Contract FG02-87ER40371. 27p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88009917/JAW.

We have continued to develop a theoretical framework for the quark and gluon structure of nuclei. Our approach features a successful phenomenological model, the quark cluster model (QCM), and an ambitious program in the non-perturbative solution of quantum field theories. We have solved a non-trivial model field theory in the strong coupling regime using a discretized light front quantization (DLFQ) scheme. The method we developed expands upon the method of Pauli and Brodsky by incorporating a dynamical treatment of the vacuum. This is a major result since we have shown directly that the light-cone vacuum is not structureless as has been traditionally claimed by some particle theorists. We have thus succeeded in elucidating the consequences of spontaneous symmetry breaking in light-cone quantization. We now propose to address QCD in low dimensionality with the purpose of extracting non-perturbative predictions for quark and gluon amplitudes in few baryon systems. Simultaneously with this new effort we will continue to develop extensions and applications of the QCM. We propose to continue predicting phenomena to be observed in high energy particle-nucleus collisions that reflect the rearrangement of quarks and gluons in nuclei. We will complete our analysis of the SLAC NE3 data to explicate the degree to which they confirm the QCM prediction of "steps" in the ratio of nuclear structure functions when Bjorken x exceeds unity. In another effort, we will perform a search for narrow resonances in electron-positron interactions high in the continuum using the Bethe-Salpeter equation. We have completed our development of microscopic effective Hamiltonians for nuclear structure which include the explicit treatment of delta resonances. These effective Hamiltonians were successfully used in constrained mean field calculations evaluating conditions for nuclei to undergo a transition from nucleon matter to delta matter. 73 refs.

41861 (IC—87/244) Geometric gauge theory of metric defects. Dong, L.K.; Zhang, H.Y.; Lung, C.W. (Academia Sinica, Shenyang, LN (China). Inst. of Metal Research). (International Centre for Theoretical Physics, Trieste (Italy)). Aug 1987. 18p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702961/JAW.

The mechanical behaviour of a material manifold with dislocations and disclinations is explored by applying nonriemannian geometry and gauge field theory. A geometric gauge theory of metric defects is introduced by local Lorentz invariance. As a result, we give the connection coefficients with the affine and the gauge connection. Taking the displacement field, the frame field and the gauge field as basic parameters, we obtain the constitutive equations and the governing equations based on a variational principle with respect to the groups of a coordinate transformation and a gauge transformation. (author). 24 refs.

41862 (IC—87/248) Quantum-electrodynamics based on self-energy. Barut, A.O. (International Centre for Theoretical Physics, Trieste (Italy)). Aug 1987. 12p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702965/JAW.

We review the basic principles and results of a formulation of quantum-electrodynamics based on the self-energy of the electron, rather than quantized fields. The applications include relativistic spontaneous emission rates, the effect of cavities on Lamb-shift, spontaneous emission and Casimir-Polder forces. We also review the relativistic two-body equations including radiative processes with applications to hydrogen, muonium and positronium spectra. (author). 15 refs, 1 tab.

41863 (IC—87/254) Hyperkahler metrics building in the 1+3 representation. The Taub-Nut case. El-Hassouni, A.; Lhallabi, T.; Saidi, E.H.; Oudrhiri-Safiani, E.G. (International Centre for Theoretical Physics, Trieste (Italy); Laboratoire de Physique Theorique, Rabat (Morocco)). (International Centre for Theoretical Physics, Trieste (Italy)). Sep 1987. 24p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702970/JAW.

We construct the HST type hyperkahler N=2 supersymmetric non-linear σ-model. We show that for 4n dimensional hyperkahler manifolds, one needs in general (n(n+1))/2 Kahler-like potentials. The n=1 and n=2 cases are studied in detail. The SU(2)xU(1) Taub-Nut model in the HST hypermultiplet representation is discussed as an illustrating example. The corresponding Taub-Nut metric is worked out explicitly. Some general features of these models are discussed. (author). 19 refs.

41864 (IC—87/255) Properties of the eleven dimensional supermembrane theory. Bergshoeff, E.; Sezgin, E.; Townsend, P.K. (International Centre for Theoretical Physics, Trieste (Italy); Cambridge Univ. (UK). Dept. of Applied Mathematics and Theoretical Physics). (International Centre for Theoretical Physics, Trieste (Italy)). Sep 1987. 36p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702971/JAW.

We study in detail the structure of the Lorentz covariant, spacetime supersymmetric 11-dimensional supermembrane theory. We show that for a flat spacetime background, the spacetime supersymmetry becomes an N=8 world volume (rigid) supersymmetry in a "physical" gauge; we also present the field equations and transformation rules in a "lightcone" gauge. We semiclassically quantize the closed toroidal supermembrane on a spacetime (Minkowski)/sub 4/ x (flat 7-torus), and review some mathematical results that are relevant for path integral quantization. (author). 52 refs, 1 fig.

41865 (IC—87/258) Massless chiral families in superstring theories. Gherman, O.; Harabor, V.; Saliu, L. (International Centre for Theoretical Physics, Trieste (Italy); Craiova Univ. (Romania)). (International Centre for Theoretical Physics, Trieste (Italy)). Aug 1987. 6p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702974/JAW.

The contribution of the U(1) and simple group factors S/sub k/ of the background gauge group S=PI/sub k/S/sub k/ to the

number of massless fermion generations in superstring theories is examined. Unlike the semisimple case when only SU(n) factors contribute to the generation number, if the Abelian factors are present, all groups contained in S contribute to it. (author). 3 refs.

41866 **(IC—87/263) Quantization scheme for scale invariant gauge theories.** Hortacsu, M. (International Centre for Theoretical Physics, Trieste (Italy)). Aug 1987. 11p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702979/JAW.

A scheme is suggested for the quantization of the recently proposed scale invariant gauge theories in higher dimensions. The model is minimally coupled to a spinor field. A regularization algorithm is proposed. (author). 8 refs.

41867 **(IC—87/321) Planck's orders of magnitude and the limits of the quantum gravity conception.** Borzeszkowski, H.H. von. (International Centre for Theoretical Physics, Trieste (Italy)). Feb 1988. 20p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702985/JAW.

In this paper it is shown how the universal constants h, c and G prevent that one can derive measurable quantum GRT effects for energies near the Planck energy. Planck's units thus screen those GRT regions where difficulties for the quantization procedure occur, from a physically sensible quantum-field (or graviton) interpretation. 22 refs.

41868 **(IC—87/380) Gluing procedures for holomorphic conformal field theories on Riemann surfaces.** Jayaraman, T.; Narain, K.S. (International Centre for Theoretical Physics, Trieste (Italy); Rutherford Appleton Lab., Chilton (UK)). (International Centre for Theoretical Physics, Trieste (Italy)). Feb 1988. 13p. (RAL—87-111). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702996/JAW.

In this note we study the gluing procedures for holomorphic conformal field theories on Riemann surfaces. Using an operator formalism, we show how to obtain the new partition function and correlation functions for the case when a handle is created on a surface or when two Riemann surfaces are glued together. In particular, for the case of 1/2-differentials we show how the extra spin-structures can be recovered. (author). 8 refs.

41869 **(IC—87/393) On closure of the light-cone gauge closed superstring algebra.** Restuccia, A.; Taylor, J.G. (International Centre for Theoretical Physics, Trieste (Italy)). Dec 1987. 10p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88703003/JAW.

We construct four-field generators to achieve closure of the 10-dimensional SUSY algebra for the heterotic and type II superstring light cone gauge field theory. Closure for the heterotic case is achieved in a regularization independent manner, whilst that for type II needs the use of constant time and phase integration regularizations. The resulting 4-field Hamiltonians are briefly related to terms arising in the amplitudes for the two theories constructed from the cubic terms alone. (author). 12 refs.

41870 **(IC—87/396) On the infinities of closed superstring amplitudes.** Restuccia, A.; Taylor, J.G. (International Centre for Theoretical Physics, Trieste (Italy)). Dec 1987. 13p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703006/JAW.

We present an analysis of possible infinities that may be present in uncompactified multi-loop heterotic and type II superstring amplitudes constructed, without use of the short-string limit, in the light-cone gauge, and with use of a closed SUSY field theory algebra. Various types of degenerations of the integrand are discussed on the string world-sheet. No infinities are found, modulo (for type II) a particular identity for Green's functions. (author). 13 refs.

41871 **(IC—87/401) Fermionization of chiral string determinants in factorizable metrics.** Iengo, R.; Ivanov, B. (International Centre for Theoretical Physics, Trieste (Italy)). Nov 1987. 13p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703159/JAW.

We use fermionization, defined as a change of variables in the functional integration, to find chiral determinants of the string integrand in any holomorphically factorizable metric. In this way we derive and generalize the formulae proposed by Knizhnik and clarify their relation to those of Eguchi, Ooguri and Verlinde, Verlinde. (author). 20 refs.

41872 **(IC—87/403) Non abelian antisymmetric tensor field revisited.** Diaz, A.H. (International Centre for Theoretical Physics, Trieste (Italy)). Dec 1987. 10p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88703160/JAW.

The ghost structure for the non abelian antisymmetric model of Freeman and Townsend is presented. The origin of the three ghost coupling in the quantum action is explained, and the counting of the propagating degrees of freedom is shown to agree with those of a non linear sigma model. (author). 7 refs, 1 fig.

41873 **(IC—87/404) On the dynamical mass generation in gauge-invariant non-linear σ-models.** Diaz, A.; Helayel-Neto, J.A.; Smith, A.W. (International Centre for Theoretical Physics, Trieste (Italy); Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro). (International Centre for Theoretical Physics, Trieste (Italy)). Dec 1987. 14p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703161/JAW.

We argue that external gauge fields coupled in a gauge-invariant way to both the bosonic and supersymmetric two-dimensional non-linear σ-models acquire a dynamical mass term whenever the target space is restricted to be a group manifold. (author). 11 refs.

41874 **(IC—87/410) Complete orthonormal sets on the past light cone - II: Functions belonging to spin 1/2 and non-zero rest mass.** Derrick, G.H. (International Centre for Theoretical Physics, Trieste (Italy)). Dec 1987. 14p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703162/JAW.

This is the second of a series of papers preparing the mathematical framework for a past light cone formulation for the quantum mechanics of particles of arbitrary mass and spin. The aim of past light cone quantum theory is to define quantum states solely in terms of data accessible to an observer, i.e. information from within his current past light cone. In order to set up such a theory one needs to define on the past light cone complete orthonormal sets of functions which belong to the appropriate representation of the Poincare group. Such functions are interpreted as energy-momentum eigenfunctions. The present paper treats the case of spin 1/2 and non-zero rest mass. (author). 7 refs.

41875 **(IC—87/411) Scalar mesons in the baryon-soliton formation.** Andrianov, V.; Novozhilov, V. (Leningrad State Univ. (USSR). Dept. of Theoretical Physics). (International Centre for Theoretical Physics, Trieste (Italy)). Dec 1987. 14p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703012/JAW.

We discuss the bag formation in effective meson theory based on chiral and conformal anomalies of QCD. We find that the QCD motivated linear σ-model uniquely defines the soliton-bubble description of the baryon. The scales of the chiral symmetry restoration R/sub c/ $\sim$ 0.07 fm and of the bosonization R/sub h/ $\sim$ 0.3-0.4 fm naturally emerge. (author). 29 refs, 1 fig., 1 tab.

41876 **(IC—87/414) Superstring vertex operators and scattering amplitudes on arbitrary Riemann surfaces.** Aldazabel, G.; Nunez, C.; Iengo, R.; Bonini, M. (International Centre for Theoretical Physics, Trieste (Italy); Istituto Nazionale di Fisica Nucleare, Trieste (Italy)). (International Centre for Theoretical Physics, Trieste (Italy)). Dec 1987. 36p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703015/JAW.

The construction of scattering amplitudes involving arbitrary bosonic mass level states is considered in both the closed superstring and in the heterotic string theories, at any order of perturbation. From massless particle scattering on a general Riemann sur-

face, the super-covariant form of the vertex operators is derived via factorization. The super-covariant rules, including the normal ordering prescriptions, to be used in computing amplitudes, are automatically given by this procedure. (author). 22 refs, 1 fig.

41877 **(IC—87/415) Effective hadronic lagrangian in the strong coupling expansion of lattice QCD with Susskind fermions.** Azakov, S.I.; Aliev, E.S. (International Centre for Theoretical Physics, Trieste (Italy); AN Azerbajdzhanskoj SSR, Baku. Inst. Fiziki). (International Centre for Theoretical Physics, Trieste (Italy)). Dec 1987. 18p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703016/JAW.

The effective hadronic action in lattice QCD with U(N) and SU(N) gauge groups and with Susskind fermions is constructed in the framework of the strong coupling approximation. For arbitrary finite (odd) N (in particular N=3) we find an effective potential, vacuum expectation value of the (chi-barchi) and an effective action for the physical meson field π(x). (author). 19 refs.

41878 **(IC—87/422) On covariant quantization of massive superparticle.** Huq, M. (International Centre for Theoretical Physics, Trieste (Italy)). Dec 1987. 29p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703021/JAW.

We have obtained, by dimensional reduction of the Green-Schwarz superstring, the action of a D=9 massive superparticle. Because of the presence of a Wess-Zumino term the action has Siegel symmetry. Harmonic variables realizing the coset space (SO(1,8))/SO(8) have been introduced to separate covariantly the fermionic constraints into irreducible first and second class constraints. Lorentz covariant gauge fixing conditions are imposed and the resulting BRST charge is of rank one and very simple in structure. (author). 21 refs.

41879 **(IC—88/1) Critical dimension for string theories.** Shiekh, A.Y. (International Centre for Theoretical Physics, Trieste (Italy)). Jan 1988. 9p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88703023/JAW.

By the addition of a non-trivial ghost total derivative to the Lagrangian, a way is found to alter the critical dimension for string theories. (author). 18 refs.

41880 **(IC—88/2) Spinning minimal surfaces without the Grassmann variables.** Barut, A.O.; Pavsic, M. (International Centre for Theoretical Physics, Trieste (Italy)). Jan 1988. 8p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88703024/JAW.

Generalizing the model of the spinning Dirac electron with Zitterbewegung we give a theory of spinning strings, membranes and p-branes in curved background spaces of arbitrary dimensions. The dynamical variables are surface co-ordinates x/sup μ/(ξ/sup α/) and a single c-number spinor z(ξ/sup α/). We use a phase space action which reduces in the limit to that of spinless membranes. A Hamiltonian formulation is also given. (author). 8 refs.

41881 **(IC—88/5) Quantum consistent supermembrane theory.** Bergshoeff, E.; Sezgin, E.; Tanii, Yoshiaki. (International Centre for Theoretical Physics, Trieste (Italy)). Jan 1988. 20p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703026/JAW.

We quantize the eleven dimensional supermembrane in AdS/sub 4/xS/sup 7/ background in which the N=8 supersymmetric classical membrane lives at the boundary of AdS/sub 4/. In a normal coordinate expansion of the supermembrane action around this background, we argue that only the quadratic part survives, and therefore the theory is exactly solvable. We compute all the generators of the OSp(8,4) symmetry of the theory. We show that the full quantum OSp(8,4) algebra is satisfied. Therefore the model is quantum consistent in the sense that it is anomaly free. (author). 23 refs.

41882 **(IC—88/6) Singletons, higher spin massless states and the supermembrane.** Bergshoeff, E.; Salam, A.; Sezgin, E.; Tanii, Yoshiaki. (International Centre for Theoretical Physics, Trieste (Italy)). Jan 1988. 13p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703027/JAW.

We analyse the spectrum of the eleven dimensional supermembrane quantized in AdS/sub 4/xS/sup 7/ background. The classical membrane lives at the boundary of AdS/sub 4/ which is S/sup 2/xS/sup 1/, and has OSp(8,4) symmetry. We find that the spectrum contains, in addition to the N=8 supersymmetric (massive) singletons (which may possibly be the ultimate preons), also massless states of all higher integer and half-integer spin. These states fill the irreducible representations of OSp(8,4) with highest spin s/sub max/=2,4,6,... The s/sub max/=2 multiplet corresponds to the states of the de Wit-Nicolai's N=8 gauged supergravity in four dimensions. (author). 24 refs.

41883 **(IC—88/7) Conformally invariant supersymmetric field theories on S/sup p/xS/sup 1/ and super p-branes.** Nicolai, H.; Sezgin, E.; Tanii, Yoshiaki. (Karlsruhe Univ. (T.H.) (Germany, F.R.). Inst. fuer Theoretische Kernphysik). (International Centre for Theoretical Physics, Trieste (Italy)). Jan 1988. 16p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703028/JAW.

We construct supersymmetric field theories on S/sup p/xS/sup 1/ for p=1,...,5. These spaces are the boundaries of the anti de Sitter space in (p+2)-dimensions. These theories are invariant under the super extension of the anti de Sitter group in (p+2)-dimensions, whose bosonic subalgebra is SO(p+1,2)+SO(N), for N=1,2,4,8. The anti de Sitter group SO(p+1,2) acts as the conformal group on S/sup p/xS/sup 1/. We conjecture that these theories describe the super p-branes propagating in AdS/sub p+2/xS/sup N-1/. The internal space is always one of the parallelizable spheres, namely S/sup 1/,S/sup 3/ or S/sup 7/. (author). 13 refs.

41884 **(IC—88/9) String without ghosts.** Shiekh, A.Y. (International Centre for Theoretical Physics, Trieste (Italy)). Jan 1988. 3p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88703030/JAW.

The string is examined to understand why, in the conformal gauge, it is possible to neglect gauge ghosts when in the critical space-time dimension. (author). 11 refs.

41885 **(IC—88/11) Open BRST algebras, ghost unification and string field theory.** Baulieu, L.; Bergshoeff, E.; Sezgin, E. (Paris-6 Univ., 75 (France). Lab. de Physique Theorique et Hautes Energies). (International Centre for Theoretical Physics, Trieste (Italy)). Jan 1988. 19p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703032/JAW.

Geometrical aspects of the BRST quantization of charged antisymmetric tensor fields and string fields are studied within the framework of the Batalin and Vilkovisky method. In both cases, candidate anomalies which obey the Wess-Zumino consistency conditions are given. (author). 18 refs, 1 fig.

41886 **(IC—88/13) Group integrals in the lattice QCD with Susskind fermions.** Azakov, S.I. (International Centre for Theoretical Physics, Trieste (Italy)). Jan 1988. 7p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88703034/JAW.

Some group integrals which appeared in the lattice QCD with Susskind fermions for zero and finite temperatures in the framework of strong coupling approximation are calculated. (author). 15 refs.

41887 **(IC—88/14) Manifestly fermionic gauge covariant quantization of massive superparticle.** Huq, M. (International Centre for Theoretical Physics, Trieste (Italy)). Jan 1988. 9p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88703035/JAW.

By introducing harmonic variables and additional fermionic coordinates all the fermionic constraints of the massive D=9 superparticle have been converted into first class constraints. Since all

the constraints are irreducible and first class BFV-BRST quantization scheme is fully applicable. The BRST charge is found to be of rank one. (author). 8 refs.

41888 (IC—88/15) One-link integral in the lattice QCD: Strong coupling. Azakov, S.I.; Aliev, E.S. (International Centre for Theoretical Physics, Trieste (Italy); Institute of Physics, Baku (USSR)). (International Centre for Theoretical Physics, Trieste (Italy)). Jan 1988. 16p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703036/JAW.

We review different calculation methods of the one-link integral, appearing in the strong coupling approximation in the lattice QCD. Some new formulae useful in the case of lattice QCD with Susskind fermions are also presented. (author). 18 refs.

41889 (IFVE-OTF—87-21) On two-dimensional formulation of four-dimensional system of self-dual Yang-Mills equations. Leznov, A.N. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1987. 4p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88703194/JAW.

Submitted to the journal Phys. Lett. .

It is shown that a number of solutions of self-dual equations system depending on a set of the arbitrary functions of the three independent arguments may be obtained from the solution of the two-dimensional problem related to the main chiral field problem in infinite-dimensional space. 5 refs.

41890 (IFVE-OTF—87-45) Phase structure of generalized Cross-Neveu models. Klimenko, K.G. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1987. 16p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703195/JAW.

A phase structure of models with n spinor multiplets has been considered in the space-time of dimension D=2,3. In the case when n=2 and D=3 there may occur vaccums chemical bond +> violating chiral invariance, as well as chemical bond-> violating P,T symmetry of the model. At D,n=2 depending on the sign of the constant g/sub 12/ there also exist two different vacua. It is shown here, that at sufficiently small g/sub 12/ the description of the model with the help of the leading order of 1/N expansion is incorrect (there appear tachyons). The properties of Gross-Neveu model have been dealt with at D=3, n=1 and the temperature and chemical potential not equal to zero. 8 refs.; 1 fig.

41891 (INIS-SU—5/A, pp 5-11) Gauging of canonical transformations in the relativistic particle theory. Filippov, A.T. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1987. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88780078/JAW. (JINR-N—3(23)-87).

In JINR rapid communications. Collection.

A relativistic theory of particles is formulated by gauging the linear canonical symmetries of the simplest bilinear Lagrangian. The resulting non-abelian group includes reparametrizations and Weyl transformations. The approach can be used for constructing a gauge theory of spinning particles as well as for string theories. 11 refs.

41892 (INIS-SU—5/A, pp 12-16) Infrared singularities of fermion propagator and their connection with the Wilson loop. Sissakyan, A.N.; Skachkov, N.B.; Solovtsov, I.L.; Shevchenko, O.Yu. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics;Gomel'skij Politekhnicheskij Inst. (Byelorussian SSR);Saratovskij Gosudarstvennyj Univ. (USSR)). 1987. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88780078/JAW. (JINR-N—3(23)-87).

In JINR rapid communications. Collection.

The factorization of infrared singularities of gauge-invariant spinor propagator is proved in the framework of QED. It turns out that this infrared factor coincides with the Wilson loop and accumulates all the dependence on the form of the path of the initial Green function. 8 refs.

41893 (INIS-SU—5/A, pp 17-23) Lorentz condition as a secondary gauge condition and its application for the field quantization. Skachkov, N.B.; Shevchenko, O.Yu. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics;Saratovskij Gosudarstvennyj Univ. (USSR)). 1987. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88780078/JAW. (JINR-N—3(23)-87).

In JINR rapid communications. Collection.

The quantization of a free electromagnetic field is performed by using a secondary gauge condition. It is proved that in contrast with the standard approach the generating functional of the Green function must contain two δ-functions with the gauge conditions under the sign of the functional integration in configurational space. 6 refs.

41894 (ITEP—78(1987)) On gluino condensation in supersymmetric gauge theories SU(N) and O(N) groups. Shifman, M.A.; Vajnshtein, A.I. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1987. 32p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703316/JAW.

Supersymmetric SU(N) and O(N) gauge theories without matter ae considered and a method for calculating the gluino condensate <TrλλA> in such theories is proposed. A general expression is obtained <TrλλA>/sub G/=Λ-tilde/sub G//sup 3/ exp(2πk/T(G)) not = 0 where Λ-tilde/sub G/ is the scale parameter, G=SU(N) of O(N), k is an integer number, T(G) is one half of the Dynkin index. For the unitary groups <TrλλA> has N different values while for the orthogonal groups (N=2) values. 18 refs.; 2 figs.

41895 (JINR—13-87-619) About unthresholdness of the Vavilov-Cherenkov radiation. Zrelov, V.P.; Lupil'tsev, V.P.; Ruzhichka, Ya. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems; Komenskeho Univ., Bratislava (Czechoslovakia). Prirodovedecka Fakulta). (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1987. 10p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88703334/JAW.

Submitted to the journal Nucl. Instrum. and Methods in Phys. Research.

Comparison of the angular distributions of the Vavilov-Cherenkov radiation (VChR) angular distributions calculated by the Ramm formulae with the transition radiation described by Pafomov's formulae and the Ginsburg-Franck formulae near the VChR threshold is made in detail. It is shown that the radiation at the velocities below the VChR threshold is a transition radiation, though not a continuous on (as in the case of particles crossing the boundary of semi-infinite media) but with maxima of different orders. This "transformed" transition radiation accounts for the unthresholdness effect earlier found by Kobzev and Frank. 9 refs.; 5 figs.

41896 (JINR-E—2-87-263) Gauge field geometry from complex and harmonic analyticities. Kaehler and self-dual Yang-Mills cases. Gal'perin, A.S.; Ivanov, E.A.; Ogievetsky, V.I.; Sokatchev, E. (Inst. Yadernykh Issledovanij, Tashkent (USSR); Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics; Bylgarska Akademiya na Naukite, Sofia. Inst. za Yadrena Izsledvaniya i Yadrena Energetika). (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1987. 24p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703344/JAW.

Submitted t the journal Ann. Phys. .

The analyticity preservation principle is employed to demonstrate and impressive affinity between field theories with intrinsic analytic structure and superfield gauge theories. The defining constraints of the former theories are interpreted as the integrability conditions for the existence of appropriate analytic subspaces and are solved by passing to the basis with manifest analyticity. We prefer to work within the analytic basis. This allows, e.g., to replace the nonlinear splitting problem of twistor approach by solving a linear equation. 24 refs.

41897 **(JINR-E—2-87-264) Gauge field geometry from complex and harmonic analyticities. Hyper-Kaeller case.** Gal'perin, A.S.; Ivanov, E.A.; Ogievetskij, V.I.; Sokatchev, E. (AN Uzbekskoj SSR, Tashkent. Inst. Yadernoj Fiziki; Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics; Bylgarska Akademiya na Naukite, Sofia. Inst. za Yadrena Izsledvaniya i Yadrena Energetika). (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1987. 28p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703345/JAW.

Submitted to the journal Ann. Phys. .

The concept of preservation of harmonic analyticity is applied to find unconstrained prepotentials of hyper-Kehler geometry. The geometric meaning of prepotentials is revealed with introducing extra central charge coordinates. Finally, we establish the one-to one correspondence between hyper-Kehler geometry and off-shell d=4, N=2 supersymmetric σ-models. Their general Lagrangian is shown to be uniquely composed of hyper-Kehler prepotentials, with the analytic space coordinates replaced by analytic hypermultiplet superfields defined on the same set of harmonic variables. 17 refs.

41898 **(JINR-E—2-87-274) Minimal quantization and confinement.** Ilieva, N.P.; Kalinowskij, Yu.L.; Nguyen Suan Han; Pervushin, V.N. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1987. 15p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703347/JAW.

Submitted to the International Conference on High Energy Physics, Sweden, 1987.

A "minimal" version of the Hamiltonian quantization based on the explicit solution of the Gauss equation and on the gauge-invariance principle is considered. By the example of the one-particle Green function we show that the requirement for gauge invariance leads to relativistic covariance of the theory and to more proper definition of the Faddeev - Popov integral that does not depend on the gauge choice. The "minimal" quantization is applied to consider the gauge-ambiguity problem and a new topological mechanism of confinement. 17 refs.

41899 **(JINR-E—2-87-555) Magnetic fluctuations in the quantized vacuum of the Georgi-Glashow model on the lattice.** Mitryushkin, V.K.; Zadorozhnyj, A.M.; Mueller-Preussker, M. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics; Humboldt-Universitaet, Berlin (German Democratic Republic)). (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1987. 11p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703074/JAW.

Submitted to the journal Phys. Lett. B.

Influence of (electro)magnetic fluctuations on the phase structure of the 4D-Georgi-Glashow model on the lattice. The distributions of (electro)magnetic fluxes and different correlations were measured using the Monte-Carlo method. 13 refs.; 8 figs.

41900 **(JINR-E—2-87-659) Gauge formulation for relativistic theories of particles and strings.** Filippov, A.T. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1987. 6p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88703352/JAW.

Submitted to the journal JETP Lett. .

It is shown, that application of the principle of localization for linear canonical symmetries permits co construct relativistic gauge theories of particles and strings proceeding from nonrelativistic ones. The known lagrangians for particles with an arbitrary spin and for a fermion string are obtained as examples. A new relativistic gauge theory for a system of N particles bound by harmonic forces is suggested; this theory may be quantized by the methods usually applied for quantization of field gauge theories. 9 refs.

41901 **(JINR-E—2-87-739) From the first to the second quantized string theory.** Karchev, N.I. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1987. 12p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703356/JAW.

Submitted to the journal Phys. Lett. .

Proceeding from hamiltonian formulation of a bose-string by the method of the continuous integral the Feynman amplitude of D(Z/sub i/, Z/sub f/) transition is calculated. An adverse to D operator and the free action in the field theory of the string are obtained. The gauge fixing procedure in the secondary quantized theory resulting in this action and thus, in the obtained propagator of the bose string is discussed. 22 refs.

41902 **(JINR-E—2-87-771) Relativistic gauge model describing N particles bound by harmonic forces.** Filippov, A.T. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1987. 8p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88703357/JAW.

Submitted to the journal Phys. Lett., B.

Application of the principle of gauging to linear canonical symmetries of simplest/rudimentary/bilinear lagrangians is shown to produce a relativistic version of the Lagrangian describing N particles bound by harmonic forces. For pairwise coupled identical particles the gauge group is T/sub 1/xU/sub 1/, xSU/sub N-1/. A model for the relativistic discrete string (a chain of N particles) is also discussed. All these gauge theories of particles can be quantized by standard methods. 11 refs.

41903 **(JINR-E—2-87-779) Canonical quantization and cosmological particle production in non-Abelian gauge theories.** Basler, M. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1987. 6p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88703358/JAW.

Submitted to the journal Phys. Lett. B.

A canonical quantization scheme for nonabelian gauge fields in an external, classical gravitational field is formulated and applied to the problem of cosmological Higgs and gauge boson production. Via interaction, the mass of the Higgs field not only leads to additional Higgs production, but also enables the production of massless bosons. 14 refs.

41904 **(JINR-E—17-87-47) Dynamical effects in the continuum trans-polyacetylene model.** Fedyanin, V.K.; Osipov, V.A. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1987. 6p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88703075/JAW.

Submitted to the Conf. on Modern Trends in Statistical Mechanics, L'vov, 1987.

The dynamical properties of the continuum trans-polyacetylene model are discussed. In the self-consistent scheme the physical characteristics of the moving solitons (kink, polaron) are calculated. 3 refs.

41905 **(JINR-R—2-87-154) Scattering of charged particles on two infinite cylindrical solenoids.** Afanas'ev, G.N. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1987. 11p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703384/JAW.

Submitted to the journal J. Math. Phys. .

Scattering of charged particles on two parallel infinite impenetrable cylindrical solenoids with magnetic fluxes of the same magnitude but opposite sign is considered. The scattering amplitude is obtained in the 1-st Born and high-energy approximations. In both cases the differential cross section is nonsingular, whereas the integral one is finite. It is shown that in the same multiconnected space with nontrival vector-potential and single-valued wave functions the Aharonov - Bohm effect may or may not exist. 15 refs.; 5 figs.

41906 **(JINR-R—2-87-502) On charged vortices in the (2+1)-dimensional Abelian Higgs model.** Inozemtsev, V.I. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1987. 6p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88703394/JAW.

Submitted to the journal Europhys. Lett. .

The asymptotic behaviour of scalar and vector fields in the classical three-dimensional Abelian Higgs model with a Chern-Simons term added to the Lagrangian is considered. The model exhibits vortices with electric charge Q. Corrections of the second order in Q to the fields describing a neutral vortex are calculated. Some arguments against to hypothesis of the doubling of possible vortex states are represented. 9 refs.

41907 **(JINR-R—2-87-542) On the expansion of the boost operator in coupling constant powers.** Kvinikhidze, A.N.; Khvedelidze, A.M. (AN Ehstonskoj SSR, Tartu. Inst. Fiziki). (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1987. 14p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703396/JAW.

Submitted to the journal Teor. Mat. Fiz. .

Representation of the boost operator as an ordered exponent is analysed. A way of expanding this operator over the coupling constant degrees is pointed out which is of interest for the description of interaction of composite systems with large momenta. This expansion was used to obtain a "mixed" representation for the form factor of a composite particle in which the wave functions of a bound state of the usual field theory and the field theory on null-plane are used simultaneously. The relation with the calculations in the system P/sub Z/ -> ∞ with longitudinal momentum transfer (q/sup +/ not = 0) is shown in calculating the asymptotic behaviour. 8 refs.; 6 figs.

41908 **(JINR-R—2-87-728) Quantization of gauge fields with allowance for secondary gauge conditions. Secondary conditions in configurational and phase spaces.** Sisakyan, A.N.; Skachkov, N.B.; Shevchenko, O.Yu. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1987. 16p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703398/JAW.

Submitted to the journal Theor. Math. Phys. .

It is shown that a correct transition from the phase to configurational space results in that the generating functionals of S-matrix and Green functions, unlike standard expressions in the Coulomb gauge, contain a product of two functional delta-functions in the integral guarantees the gauge field. The product of these functions guarantees, first, simultaneous fulfilement of the Coulomb conditions and the Gauss law (the Gauss law with interaction and the Gauss law without interaction) and, second, the equality of the number of independent components of the vector field of integration to the number of physical degrees of freedom of the gauge field. 15 refs.

41909 **(JINR-R—2-87-729) Quantization of gauge fields under secondary gauge conditions. Primary gauges of the form PHI/sup μ/B/sub μ/=0.** Sisakyan, A.N.; Skachkov, N.B.; Shevchenko, O.Yu. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1987. 19p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703399/JAW.

Submitted to the journl Theor. Math. Phys. .

For all primary-gauge conditions, linear in the gauge fields, of the form PHI/sup μ/B/sub μ/=0, expressions are obtained for the generating fucntionals of S-matrix and Green functions which, in addition to δ(PHI/sup μ/B/sub μ/), contain also a delta-function guaranteeing fulfilment of the Gauss law in the functional integral over the vector field B/sub μ/. 9 refs.; 2 figs.

41910 **(JINR-R—2-87-782) On stochastic confinement.** Efimov, G.V. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1987. 12p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703400/JAW.

Submitted to the journal Theor. Math. Phys. .

It is shown that the gluon vacuum considered as a stohastic field with the correlation function decreasing at great distances cannot provide for the confinement. 3 refs.

41911 **(JINR-R—4-87-106) Vector magnetic potentials of a toroidal solenoid.** Afanas'ev, G.N. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1987. 14p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703404/JAW.

Submitted to the journal J. Phys. A.

The vector-potentials of the toroidal solenoid are obtained both in the Coulomb and non-Coulomb gauges. Their properties are studied. In the first case it decreases as r/sup -3/ at large distances, while in the second one it differs from zero in the nearest vicinity of the solenoid. The gauge transformation connecting these potentials is found. 8 refs.; 2 figs.

41912 **(JINR-R—4-87-107) Charged particle scattering by the magnetic field of a toroidal solenoid.** Afanas'ev, G.N. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1987. 15p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703405/JAW.

Submitted to the journal J. Phys. A.

The scattering amplitude of the charged particles on the toroidal solenoid is obtained in the 1-st Born and high-energy approximations. The concrete examples are presented showing that in the same multiconnected space with a nontrivial vector-potential in it the Aharonov-Bohm effect may or may not exist. 14 refs.; 5 figs.

41913 **(KFKI—1987-71/A) Series expansion solution of the Wegner-Houghton renormalisation group equation.** Margaritis, A.; Odor, G.; Patkos, A. (Hungarian Academy of Sciences, Budapest. Central Research Inst. for Physics; Eoetvoes Lorand Tudomanyegyetem, Budapest (Hungary). Atomfizikai Tanszek). (Hungarian Academy of Sciences, Budapest. Central Research Inst. for Physics). Nov 1987. 22p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703427/JAW.

Submitted to Z. Phys. (Germany F.R.).

The momentum independent projection of the Wegner-Houghton renormalisation group equation is solved with power series expansion. Convergence rate is analyzed for the n-vector model. Further evidence is presented for the first order nature of the chiral symmetry restoration at finite temperature in QCD with 3 light flavors. (author) 16 refs.

41914 **(KMU-HEP—87-02) Study of Z(n)-gauge theories on a three-dimensional pseudorandom lattice.** Pertermann, D.; Ranft, J. (Karl-Marx-Universitaet, Leipzig (German Democratic Republic). Sektion Physik). (Karl-Marx-Universitaet, Leipzig (German Democratic Republic)). Oct 1987. 17p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703451/JAW.

Using the simplicial pseudorandom version of lattice gauge theory we study simple Z(n)-gauge models in D = 3 dimensions. In this formulation it is possible to interpolate continuously between a regular simplicial lattice and a pseudorandom lattice. Calculating average plaquette expectation values we look for the phase transitions of the Z(n)-gauge models with n = 2 and 3. We find all the phase transitions to be of first order, also in the case of the Z(2)-model. The critical couplings increase with the irregularity of the lattice.

41915 **(NBI-HE—87-55) Amorphous gauge glass theory.** Nielsen, H.B.; Bennett, D.L. (Niels Bohr Inst., Copenhagen (Denmark)). Aug 1987. 11p. (CONF-8706211—). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88752695/JAW.

From Workshop on statistical physics; Lyngby, Denmark (9 Jun 1987).

Assuming that a lattice gauge theory describes a fundamental attribute of Nature, it should be pointed out that such a theory in the form of a gauge glass is a weaker assumption than a regular lattice model in as much as it is not constrained by the imposition of translational invariance; translational invariance is, however, recovered approximately in the long wavelength or continuum limit.

41916 **(NORDITA—88/10-P-Prepr.) N-string vertex and multiloop calculations in the bosonic string.** Di Vecchia, P.; Hornfeck, K.; Frau, M.; Lerda, A.; Sciuto, S. (Nordisk Inst. for Teoretisk Atomfysik, Copenhagen (Denmark); Nordisk Inst. for Teoretisk Atomfysik, Copenhagen (Denmark); Wuppertal Univ. (Gesamthochschule) (Germany, F.R.); Istituto Nazionale di Fisica Nucleare, Turin (Italy); Niels Bohr Inst., Copenhagen (Denmark); State Univ. of New York, Stony Brook (USA). Inst. for Theoretical Physics; Naples Univ. (Italy). Dipt. di Scienze Fisiche; Istituto Nazionale di Fisica Nucleare, Naples (Italy)). (Nordisk Inst. for Teoretisk Atomfysik, Copenhagen (Denmark); Wuppertal Univ. (Gesamthochschule) (Germany, F.R.); Istituto Nazionale di Fisica Nucleare, Turin (Italy); Niels Bohr Inst., Copenhagen (Denmark); State Univ. of New York, Stony Brook (USA). Inst. for Theoretical Physics; Istituto Nazionale di Fisica Nucleare, Naples (Italy)). 1988. 17p. (CONF-871294—). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88754034/JAW.

From Workshop on superstring theory; Kanpur, India (13 Dec 1987).

In these lectures we describe the BRST invariant N-string vertex and show how to use it together with the BRST invariant twisted propagator for computing the multilop diagrams in the bosonic string. We then compare our approach with other approaches used for evaluating higher order perturbative contributions in string theories.

41917 **(NORDITA—88/11-P(prepr.)) N-string, g-loop vertex for the bosonic string.** Di Vecchia, P.; Hornfeck, K.; Frau, M.; Lerda, A.; Sciuto, S. (Nordisk Inst. for Teoretisk Atomfysik, Copenhagen (Denmark); Nordisk Inst. for Teoretisk Atomfysik, Copenhagen (Denmark); Wuppertal Univ. (Gesamthochschule) (Germany, F.R.); Istituto Nazionale di Fisica Nucleare, Turin (Italy); Niels Bohr Inst., Copenhagen (Denmark); State Univ. of New York, Stony Brook (USA). Inst. for Theoretical Physics; Naples Univ. (Italy). Dipt. di Scienze Fisiche; Istituto Nazionale di Fisica Nucleare, Naples (Italy)). (Nordisk Inst. for Teoretisk Atomfysik, Copenhagen (Denmark); Nordisk Inst. for Teoretisk Atomfysik, Copenhagen (Denmark); Nordisk Inst. for Teoretisk Atomfysik, Copenhagen (Denmark); Wuppertal Univ. (Gesamthochschule) (Germany, F.R.); Istituto Nazionale di Fisica Nucleare, Turin (Italy); Niels Bohr Inst., Copenhagen (Denmark); State Univ. of New York, Stony Brook (USA). Inst. for Theoretical Physics; Istituto Nazionale di Fisica Nucleare, Naples (Italy)). 1988. 14p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88754035/JAW.

We construct the N-string, g-loop vertex V/sub N,g/ for the orbital degrees of freedom of the bosonic string in terms of the first abelian differentials, the period matrix and the prime form. We also build the vertical stroke g > vacuum recently discussed by many people in the framework of an operator formalism on an arbitrary Riemann surface; our expression also contains the measure that takes into account the ghost contribution.

41918 **On the physical interpretation of the Vilkovisky-Dewitt effective action.** Burgess, C.P.; Kunstatter, G. (Physics Dept., McGill Univ., 3600 University St., Montreal, PQ H3A 2T8 (CA)). *Modern Physics Letters A;* 2: No. 11, 875-886(Nov 1987).

This letter examines the physical interpretation of a class of reparameterization-invariant effective actions, recently introduced by DeWitt. These include as a special case the Vilkovisky and DeWitt effective action. The invariant actions are shown to share those features at the root of the utility of the standard effective action. In particular, they can be interpreted as the minimum energy in states that are subject to a reparameterization-invariant constraint. It is also shown that, contrary to standard lore, although the Vilkovisky-DeWitt action is given as the sum of one-particle-irreducible graphs it is not the generator of 1PI n-point functions.

41919 **The theorems of perturbative QCD.** Collins, J.C.; Soper, D.E. (Dept. of Physics, Illinois Institute of Technology, Chicago, IL 60616 (US)). pp 383-410 of Annual review of nuclear and particle science, Volume 37. Jackson, J.D. Palo Alto, CA; Annual Reviews Inc. (1987).

In this review the authors discuss a sampling of important results (particularly factorization theorems) for which there is a statement of the result at all orders of perturbation theory and a reasonable approximation to a proof. They consider as outside their scope results for which only the first term in a leading logarithm expansion is available. The emphasize that some of the topics left out of this review will ultimately become the subject of theorems of the power of those that they do discuss. The authors first summarize the kinds of theorems and possible theorems that are available. Then they cover the foundations of the subject, starting with renormalization. After that they discuss the various factorization theorems and expose the key steps in their proof. Finally the authors indicate where they believe future work in the field should go, and also indicate their opinion of how well the theorems are proved.

41920 **String theory and holomorphic line bundles.** Alvarez, O. (Lawrence Berkeley Lab., Univ. of California, Berkeley, CA (US)). pp 486-498 of Proceedings of the seventh workshop on grand unification/ICOBAN '86. Arafune, J. Teaneck, NJ; World Scientific Pub. Co. (1987). (CONF-8604202—).

From 7. workshop on grand unification; Toyama City, Japan (16 Apr 1986).

Some elementary facts about holomorphic line bundles are discussed along with some applications to string theory.

41921 **Recent issues in supergravity theories.** Ferrara, S. (Univ. of California, Los Angeles, CA (US)). pp 411-430 of Proceedings of the seventh workshop on grand unification/ ICOBAN '86. Arafune, J. Teaneck, NJ; World Scientific Pub. Co. (1987). (CONF-8604202—).

From 7. workshop on grand unification; Toyama City, Japan (16 Apr 1986).

Some aspects of supergravity theories, obtained as point field limit of superstrings are discussed. Positive semidefinite potentials in extended sueprgravities obtained from dimensional reduction of D = 10 theories are considered. The supersymmetric completion of Chern-Simons terms and of higher curvature invariants is also analyzed.

41922 **A string primer.** Bachas, C. (Stanford Linear Accelerator Center, Stanford Univ., Stanford, CA (US)). pp 502-519 of Proceedings of the 2nd Hellenic School on elementary particle physics. Argyres, E.N.; Zoupanos, G. Teaneck, NJ; World Scientific Pub. Co. (1986). (CONF-8509280—).

From 2. Hellenic school on elementary particle physics; Corfu, Greece (1 Sep 1985).

This is an elementary introduction to the classical and quantum mechanics of a single bosonic string, and to some aspects of its supersymmetric and heterotic extensions.

65 PHYSICS II

REFER ALSO TO CITATION(S) 41756

41923 **(INIS-SU—5/A) JINR rapid communications. Collection.** (Joint Inst. for Nuclear Research, Dubna (USSR)). 1987. 50p. (In Russian). (JINR-N—3(23)-87). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88780078/JAW.

Separate abstracts were prepared for individual papers in this collection.

6510 Nuclear Physics

REFER ALSO TO CITATION(S) 40807, 41077, 41079, 41771, 41776

41924 (INP—1268/PL, pp 299-334) **Nuclear structure effects on the mechanism of deep inelastic collisions below 10 MeV/u.** Rudolf, G. Sep 1984. NTIS (US Sales Only), PC A20/MF A01. Order Number DE88701632/JAW. (CONF-8404157—).

From 19. winter school on physics; Zakopane, Poland (3 Apr 1984).

The mechanism of deep inelastic reactions below 10 MeV/u is reexamined in a way which allows to emphasize nuclear structure effects. The influence of the potential energy surface on the nucleon exchange mechanism is studied in the framework of Boltzmann statistics. The similarity with transport theory is discussed. Simple expressions for the first and second moments of mass and charge distributions are derived, which allow to extract the number of exchanged protons and neutrons from the experimental data. The total kinetic energy loss corrected for the variation of Coulomb repulsion is introduced as a scale for the number of exchanged nucleons; the choice of this observable is discussed. Applying these results, experimental data are reviewed in order to search for nuclear structure effects. Several positive evidences are presented, showing the possibility to gain information about the reaction mechanism through the study of such effects. 37 refs., 23 figs.

41925 (JAERI-M—88-065) **Proceedings of the 1987 seminar on nuclear data.** Nakagawa, Tsuneo; Zukeran, Atsushi (eds.). (Japan Atomic Energy Research Inst., Tokai, Ibaraki. Tokai Research Establishment). Mar 1988. 521p. (NEANDC(J)—127/U; INDC(JPN)—113/L; CONF-8711173—). Japan Atomic Energy Research Institute, Tokai-mura, Naka-gun, Ibaraki-ken 319-11, Japan;1. Order Number TI88008591/JAW.

From Seminar on nuclear data; Tokai, Japan (12 Nov 1987).

The 1987 Seminar on Nuclear Data was held by the Japanese Nuclear Data committee and the Nuclear Data Center, at the Tokai Research Establishment of the Japan Atomic Energy Research Institute, on November 12 and 13, 1987. Main topics of the seminar were (1) evaluation of nuclear data for JENDL-3 and (2) benchmark test of JENDL-3T. Some topical review presentations were also made on interesting fields for post-JENDL-3 activity. This report contains the 36 papars given at the seminar.

41926 (JINR-R—1-87-471) **Study of pC interactions at P/sub p/=10 GeV/c with emission of cumulative deuterons.** Armutlijski, D.; Kopylova, D.K.; Lyubimov, V.B. and others. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1987. 7p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88703376/JAW.

Submitted to the journal Sov. J. Nucl. Phys. .

The pC interactions at P/sub p/=10 GeV/c accompanied by deuteron emission at 0.6 to ~ 1.3 GeV/c momentum in an angular interval of more than 135 deg are analysed. The work has been performed using pictures from the 2-m propane bubble chamber. The results on cross sections of these interactions, on secondary particle characteristics in them and on azimuthal correlations between cumulative baryons and other protons were found to be close to the data on pC collisions with the emission of cumulative protons. Similar results have been obtained for the size of the emission region of knocked out nucleons which form a cumulative deuteron due to fusion, and of the emission region of nucleons in the events with cumulative protons. 6 refs.; 1 fig.; 2 tabs.

41927 (ZfK—592, pp 114-116) **Linear momentum transfer to residual nuclei leading to fission.** Andronenko, L.A.; Kotov, A.A.; Vaishnene, L.A.; Neubert, W. (AN SSSR, Leningrad. Inst. Yadernoj Fiziki; Zentralinstitut fuer Kernforschung, Rossendorf bei Dresden (German Democratic Republic)). Apr 1986. NTIS (US Sales Only), PC A09/MF A01. Order Number DE88780092/JAW. (CONF-8511312—).

From 15. international symposium on nuclear physics - nuclear fission; Gaussig, German D.R. (11 Nov 1985).

The angular correlations of coincident fragments emitted from U, Bi, Au, W, Yb, Ho, Sm, Sb, Ag and Ni targets bombarded with 1 GeV-protons were measured with a double-arm spectrometer including a position-sensitive parallel plate avalanche counter. The forward momentum <p> was deduced from the folding angles. <p> as function of Z/sup 2//A levels off below Z/sup 2//A ~ 25 and indicates a limit of energy deposition in these nuclei.

41928 (ZfK—592) **Proceedings of the 15. International Symposium on Nuclear Physics. Nuclear Fission.** Seeliger, D.; Seidel, K.; Maerten, H. (eds.). (Zentralinstitut fuer Kernforschung, Rossendorf bei Dresden (German Democratic Republic)). Apr 1986. vp. (CONF-8511312—). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88780092/JAW.

From 15. international symposium on nuclear physics - nuclear fission; Gaussig, German D.R. (11 Nov 1985).

The individual papers presented in this conference have been abstracted and indexed separately. (DWL)

6511 Experimental Techniques

41929 (DOE/ER/40277—2) **[Direct mass and lifetime measurements of neutron rich nuclei up to A=100 using the TOFI spectrometer]: Annual technical progress report, 1987.** (Utah State Univ., Logan (USA)). 1987. Contract FG02-86ER40277. 3p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE88008302/JAW.

This report discusses experiments done on mass measurements of neutron-rich nuclei by the TOFI spectrometer.

6512 Nuclear Properties And Reactions, A=1-5, Experimental

41930 (CEA-CONF—9315) **High proton momenta and short range nucleon-nucleon correlations in a /sup 3/He(e,e'p) experiment.** Marchand, C.; Bernheim, M.; Dunn, P.C. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Service de Physique Nucleaire a Haute Energie). 1987. 5p. (CONF-8708143—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88753926/JAW.

From 11. European conference on few-body physics; Fontevraud, France (31 Aug 1987).

Electron scattering cross sections for the /sup 3/He(e,e'p) reaction have been measured for recoil momenta between 300 and 600 MeV/c and up to 90 MeV missing energy. The proton momentum distributions in /sup 3/He have been obtained in Plane Wave Impulse Approximation (PWIA) from 318 to 600 MeV/c for the pd channel and from 290 to 515 MeV/c for the ppn channel and are corrected for interaction effects. The ppn continuum exhibits a clear evidence for short-range nucleon-nucleon correlations.

41931 (CEA-CONF—9316) **Isoscalar and isovector electromagnetic properties of few-nucleon systems.** Martino, J. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Service de Physique Nucleaire a Haute Energie). 1987. 13p. (CONF-8708143—). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88753927/JAW.

From 11. European conference on few-body physics; Fontevraud, France (31 Aug 1987).

The recent results from electron scattering (elastic and threshold break-up) on 2- and 3-nucleon systems are presented. The separation of the charge (timelike) or magnetic (spacelike) and isoscalar or isovector components of the observables will be of greatest help for the forthcoming necessary global and coherent comparison and description of the A=2 and A=3 systems. The presented experimental results will be illustrated by some of the most recent theoretical calculations including non nucleonic degrees of freedom: comparisons will mainly be done with mesonic approaches; calculations introducing explicitly quark degrees of freedom will be illustrated simply in the case of the /sup 3/He charge form factor.

Details on the different theoreticl approaches illustrated in the present report are to be found in the theoretical contributions to this Conference, and in the quoted references.

41932 **(CEA-CONF—9317) Precise measurements of the deuteron A(q/sup 2/) structure function.** Hachemi, H.; Amroun, A.; Auffret, S.; Sick, I. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Service de Physique Nucleaire a Haute Energie). 1987. 7p. (CONF-8708143—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88753928/JAW.

From 11. European conference on few-body physics; Fontevraud, France (31 Aug 1987).

Difficulty comes from the experimental side. Precise data between q/sup 2/ = 1 and 18 fm/sup -2/ are reported in the present paper. The experiment was performed at the Saclay electron linear accelerator (ALS) using the standard equipment of the HE1 experimental hall. Data were taken at four incident energies: 200, 300, 500 and 650 MeV. We have used the same target and detection system, as those used for the measurement of the B(q/sup 2/) structure function.

41933 **(CEA-CONF—9318) Photo-absorption mechanism in /sup 3/He around the delta (1232) resonance.** Tamas, G. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Service de Physique Nucleaire a Haute Energie). 1987. 9p. (CONF-8708143—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88753929/JAW.

From 11. European conference on few-body physics; Fontevraud, France (31 Aug 1987).

Pion production and photodisintegration of /sup 3/He are studied in the Δ resonance region to try to separate the various photon absorption mechanism by one two or three nucleons. The results are compared to the existing models.

41934 **(CEA-N—2538) Study of strange dibaryonic systems in the reactions $K^- + d \rightarrow K^+ + X^-$, $K^- + d \rightarrow \pi^- + X^+$ and $\pi^+ + d \rightarrow K^+ X^+$ between .9 and 1.4 GeV/c.** Pigot, C. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Dept. de Physique des Particules Elementaires; Paris-11 Univ., 91 - Orsay (France)). Jun 1987. 177p. (In French). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88752564/JAW.

This thesis presents the results of the analysis of the experiment "Dibaryon" (PS 159), performed at CERN. This experiment studies the strange dibaryonic systems in the reactions K/sup -/ + d -> K/sup +/ + X/sup -/, K/sup -/ + d -> π/sup -/ + X/sup +/ and π/sup +/ + d -> K/sup +/ + X/sup +/ between .9 and 1.4 GeV/c. A dibaryon, with strangeness -2, is searched for in the reaction K/sup -/ + d -> K/sup +/ + X/sup -/. An upper limit for the production cross section of such a state is established in the range 5 to 40 nb/sr, for a dibaryon mass between 2100 to 2500 MeV/c/sup 2/. A signal in the mass spectrum of the X/sup +/ system, at 2129 MeV/c/sup 2/, already indicated in the reaction K/sup -/ + d -> π/sup -/ + X/sup +/, is observed in the reaction π/sup +/ + d -> K/sup +/ + X/sup +/. A study of this signal is performed in these two channels at different energies. The triangular diagram model, with an intermediary sigma exchanged, is in good agreement with the variation of the production cross section in the two channels and as a function of the energy.

41935 **(CRN-PN—87-31) Experimental study of the reaction p vector d -> π /sup -/X. Research of multibaryonic resonances.** Benabdelouahed, D. (Strasbourg-1 Univ., 67 (France). Centre de Recherches Nucleaires). Nov 1987. 105p. (In French). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88753947/JAW.

The polarized proton beam is produced by the synchrotron of the National Laboratory Saturne (LNS), at incident energies of 1.45 GeV, 2.1 GeV and 2.7 GeV. The pions were detected at an angle 13/sup 0/, with the magnetic spectrometer SPES-III. The limits of the cross section for the formation of tribaryon resonances are given as functions of missing mass, in the range between 3 GeV et 3,8 GeV. At the 1,45 GeV incident energy two structures located near the acceptance limit of the spectrometer are interpreted in term of conventional physics. The first structure near a mass of 2855 MeV should be from the nucleon-nucleon interactions in the final state whereas the second one at about 2950 MeV is attributed to the upper thresholds of different pion production reactions. The analysing power variations are attributed to two baryons interactions in the final state rather than to a manifestation of possible tribaryon resonances. A qualitative agreement has been obtained between the values of the cross sections measured at the incident energy of 1.45 GeV and the theoretical values obtained with a model based on meson exchange. This model does not reproduce the variations of the analysing power.

41936 **(IPNO-TH—87-42) On some open Σ hypernuclear problems.** Bouyssy, A.; Zofka, J. (Paris-11 Univ., 91 - Orsay (France). Inst. de Physique Nucleaire). 1987. 6p. (CONF-8706233—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88780095/JAW.

From International conference on intermediate energy nuclear physics; Balatonfured, Hungary (8 Jun 1987).

Present situation in understanding the Σ-hypernuclei is briefly reviewed here. In particular, Σ-hypernuclear characteristics and their model descriptions are discussed. Also the quasifree process inclusions are described.

41937 **(ITEF—76(1987)) Reaction of quasi-elastic recharge p/sup 3/He->n/sub F/ ppp at mean energies.** Blinov, A.V.; Vanyushin, I.A.; Grechko, V.E. and others. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1987. 24p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703293/JAW.

The main characteristics of the p/sup 3/He -> n/sub F/ppp quasi-elastic charge-exchange reaction are studied using a liquid-hydrogen bubble chamber of 80 cm diameter exposed to /sup 3/He nuclei fluxes at 2.5 GeV/c and 5 GeV/c momenta (the initial proton kinetic energy in the nucleus rest system is 0.318 GeV and 0.978 GeV, respectively). The experimental data are compared with the predictions of the Glauber-Sitenko multiple scattering theory and the pole model taking into account spectator nucleons in the finite state. In the 3p-system mass spectrum at 3.05 GeV a highly pronounces structure, which is not described within the framework of the pole model, is observed. A probable resonance origin of the given structure is discussed. 18 refs.; 7 figs.

6513 Nuclear Properties And Reactions, A=6-19, Experimental

41938 **(CEA-CONF—9165) Overlook on hypernuclear physics.** Bertini, R. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Service de Physique Nucleaire a Moyenne Energie). Apr 1987. 21p. (CONF-8703136—). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88753887/JAW.

From Elementary structure of materials; Les Houches, France (24 Mar 1987).

In the perspective of future developments of this field, the present status of our knowledge of hypernuclear physics will be resumed in this lecture, without, because lack of space, any pretention of completeness.

41939 **(IPNO-DRE—87-20) Search for short lived neutral particle in the 15.1 MeV isovector transition of ^{12}C.** Datar, V.M.; Fortier, S.; Gales, S.; Hourani, E. (Paris-11 Univ., 91 - Orsay (France). Inst. de Physique Nucleaire). 1987. 14p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88752456/JAW.

We report a search for a short lived neutral particle PHI emitted in the decay of the 15.1 MeV J/sup π/ (T) = 1/sup +/ (1) state in /sup 12/C. The experiment is sensitive to PHI -> e/sup +/e/sup -/ decays and finds no evidence for such a particle. We set upper limits on Γ/sub PHI//Γ/sub γ/ for mean lifetimes between {similar←to} 10/sup -13/ sec to {similar←to} 10/sup -8/ sec and in the mass range 1.02 MeV to {similar←to} 2.5 MeV.

41940 **(NEANDC(E)—240/L) Neutron elastic and inelastic scattering from ^{14}N between 7.7 and 13.5 MeV.** Chardine, J.; Haouat, G.; Seguin, S.; Humeau, C. (CEA, 75 - Paris (France)). Oct 1986. 83p. (In French). (CEA-N—250; INDC(FR)—69/L). NTIS (US Sales Only), PC A07;1; GPO Dep. Order Number DE88011274/JAW.

Differential cross sections are reported for neutron elastic and inelastic scattering by ^{14}N at incident energies of 7.67, 7.90, 8.11, 9.00, 10.30, 10.65, 11.00, 11.50, 12.40, and 13.50 MeV. These data were measured by means of the time-of-flight technique and a liquid nitrogen scattering sample. The results are compared to previous data and to the ENDF/B.IV evaluation. Large discrepancies are observed between the data and the ENDF/B.IV evaluation, and suggest a revision of this file. This would help to understand better the problems encountered in neutron transport and dosimetry calculations in the atmosphere.

41941 **Neutron-induced photon production cross sections.** Ramakrishnan, P.; Mitchell, G.E.; Gould, C.R.; Wender, S.A.; Achampaugh, G.F.; Little, R.C. (North Carolina State Univ., Raleigh, NC (US)). *Nuclear Science and Engineering;* **98**: No. 4, 357-364(Apr 1988).

A procedure for the determination of neutron-induced photon production cross sections is described, including corrections for the neutron-induced photon background and the unfolding of the gamma-ray spectra. As an example, data have been obtained for tantalum and beryllium with five bismuth germanate detectors and the high-energy white neutron source at the Los Alamos Meson Physics Facility. Calculations and measurements indicate that a beryllium sample may be used to simulate a neutron-induced photon background. Results for the Ta(n,chiγ) reaction for neutron energies below E/sub n/ = 20 MeV are compared with previous measurements at the Oak Ridge Electron Linear Accelerator.

41942 **Studies of hypernuclei by associated production.** Chrien, R.E.; Pile, P.H.; Bart, S.; Sutter, R.J.; Tsoupas, N.; Peng, J.C.; Mishra, S.; Kishimoto, T.; Tang, L.G.; Xu, Z. (Brookhaven National Lab., Upton, NY (USA)). *Nuclear Physics* [*Section*] *A;* **478**: vp(Feb-Mar 1988). (CONF-870413—).

From 11. international conference on particles and nuclei; Kyoto, Japan (20 Apr 1987).

Also published as report BNL—39723; CONF-870413—1.

The spectroscopy of hypernuclei across a wide range of mass number has been studied by the associated production (π/sup +/,K/sup +/) technique. The energies of Λ single particle states in the s, p, d, and f shells have been determined as a function of A. It is demonstrated that the (π/sup +/,K/sup +/) reaction is the method of choice for studying Λ-bound levels of hypernuclei.

6514 Nuclear Properties And Reactions, A=20-38, Experimental

41943 **(CRN-PN—87-23) Study of nuclei far from the stability line. Mass measurements and emission analysis of delayed particles.** Dessagne, P. (Strasbourg-1 Univ., 67 (France). Centre de Recherches Nucleaires). Nov 1987. 247p. (In French). NTIS (US Sales Only), PC A11/MF A01. Order Number DE88753946/JAW.

Experiments were made at Isolde (CERN) Strasbourg and Orsay tandem, and Ganil. Decay mode of delayed-neutron and delayed-proton emitter nuclei with mass around 30 and 70 (/sup 32/Ar, /sup 33/Ar, /sup 65/Ge, /sup 69/Se, /sup 29/Na, /sup 30/Na). Energy and information on structure of bound states of daughter nuclei and on Gamow-Teller transition strength. Analysis by autocorrelation method of delayed-proton energy spectra of /sup 65/Ge and /sup 69/Se allows to set the level density above the separation energy of the particle in the emitter nucleus. Lifetime of unbound states (in 10/sup -6/ second field) in /sup 69/As can be estimated. Mass excess of /sup 49/K, /sup 50/K and /sup 42/Cl was determined experimentally; a new measurement was made for /sup 40/Cl. Mass excess of /sup 147/Gd was measured again with a two body reaction /sup 144/Sm (/sup 12/C, /sup 9/Be)/sup 147/Gd. Theoretical and experimental continuation of previous work was developed on heavy isotopes of iron and nickel. The half-life of the doubly-magic nucleus /sup 68/Ni first excited state was measured and compared to theoretical calculations. Beta decay of heavy isotopes of elements from chromium to zinc was also studied to measure their half-life.

41944 **(INIS-mf—11254) Applications of heavy-ion reactions on hydrogen isotopes.** Evers, E.J. (Rijksuniversiteit Utrecht (Netherlands)). 2 Nov 1987. 73p. NTIS (US Sales Only), PC A04/MF A01. Order Number DE88703265/JAW.

Contains summary in Dutch and previously published material.

This thesis describes various aspects of 'inverse' reactions between the lightest nuclides, hydrogen and deuterium, and heavy ions in the range from carbon to phosphorus. The reactions studied in this thesis always result in one light ejectile and one excited heavy nucleus. Coincidence experiments have been performed in which both the emitted light particle and the gamma radiation emitted by the excited heavy nucleus produced, are detected. Ch. 1 describes the system built for the acquisition of data obtained in such coincidence experiments. Ch. 2 describes precision measurements of nuclear lifetimes and stopping powers. Coincident Doppler shift attenuation (DSA) experiments were performed with the reaction / sup 2/H(/sup 31/P,pγ)/sup 32/P at E(/sup 31/P/sup 7+/)=50 MeV and thin Ti/sub 2/H targets on Au, Ag and Cu backings. Mean lifetimes of the E/sub x/=513, 1150, 1323 and 1755 levels were determined with experimental stopping powers of Forster et al. These lifetimes were used as input in further analysis of the experimental data and of an additional experiment with a target on Mg backing to determine a consistent set of stopping power data for P ions with a velocity in the range 0-8(c/137) in the four materials mentioned. Ch.'s 3 and 4 deal with narrow resonances in reactions of nitrogen and fluorine beams with hydrogen targets. In Ch. 3 a method is described for the calibration of analyzing-magnet systems of heavy-ions accelerators. Ch. 4 describes an experiment to investigate the hydrogen concentration in silicon nitride films using a resonant inverse nuclear reaction. This method turns out to be a very suitable one for determining hydrogen concentration profiles with a good depth resolution over a large depth. 69 refs.; 23 figs.; 7 tabs.

6515 Nuclear Properties And Reactions, A=39-58, Experimental

41945 **(GANIL-P—87-19) Some features of nucleus-nucleus collisions at intermediate energies.** Detraz, C. (Grand Accelerateur National d'Ions Lourds (GANIL), 14 - Caen (France)). 1987. 40p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88752451/JAW.

The so-called intermediate energies are energies for which different reaction mechanisms, intrinsically incompatible, are expected to compete. An energy of a few tens of MeV per nucleon is the limit between two different regimes of nuclear reactions. The characteristics of the changing collision mechanism are detailed in these lectures, particularly through information collected during the first five years of operation of Ganil. Then a synthesis of new nuclear species in intermediate energy heavy ion reactions is given.

41946 **(IFUSP-P—643) Measurement of pressure dependent perturbed angular correlations of excited /sup 41/K nuclei recoiling in argon gas.** Lepine-Szily, A.; Sala, O.; Seale, W.A.; Silveira, E.F. da. (Sao Paulo Univ. (Brazil). Inst. de Fisica; Pontificia Univ. Catolica do Rio de Janeiro (Brazil). Dept. de Fisica). (Sao Paulo Univ. (Brazil). Inst. de Fisica). 1987. 25p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703172/JAW.

The pressure dependence of G/sub 2/(∞) was measured for the 1294 Kev transition deexciting the second excited state of /sup 41/K (tau = 10,7 ns). The /sup 41/K was produced by the capture of 1.1 Mev protons by /sup 40/Ar, it has 27 Kev initial energy and recoils in the Ar gas colliding with Ar atoms. The pressure dependence presents a strong minimum around 100 torr, which can be understood as a resonance effect ocurring when the collision frequency is the same as the hyperfine frequency, inducing transitions between the different magnetic substrates of the atom. (M.W.O.).

41947 (ZfK—592, pp 184-187) **Two target Doppler Shift Attenuation Method following the (n,n'γ) reaction with fast reactor neutrons.** Georgieva, M.; Elenkov, D.; Toumbev, G. (Bylgarska Akademiya na Naukite, Sofia. Inst. za Yadrena Izsledvaniya i Yadrena Energetika). Apr 1986. NTIS (US Sales Only), PC A09/MF A01. Order Number DE88780092/JAW. (CONF-8511312—).

From 15. international symposium on nuclear physics - nuclear fission; Gaussig, German D.R. (11 Nov 1985).

A version of the Doppler Shift Attenuation Method (DSAM) has been applied for the first time to measure lifetimes of nuclear states excited in the (n,n') reaction with reactor fast neutrons simultaneously in two targets. The experimental arrangement and the procedure of experimental data treatment are briefly described.

6516 Nuclear Properties And Reactions, A=59-89, Experimental

41948 **(BNL—41260) Spectroscopy of /sup 87,88,89/Sr with (n,γ) and (d,p) reactions.** Winter, C.; Krusche, B.; Lieb, K.P.; Hlawatsch, G.; Egidy, T.V.; Hoyler, F.; Casten, R.F. (Brookhaven National Lab., Upton, NY (USA); Goettingen Univ. (Germany, F.R.). 2. Physikalisches Inst.; Technische Univ. Muenchen, Garching (Germany, F.R.). Physikdepartment; Institut Laue-Langevin, 38 - Grenoble (France)). [1988]. Contract AC02-76CH00016. 8p. (CONF-8804119—2). NTIS, PC A02/MF A01; GPO Dep. Order Number DE88010854/JAW.

From International workshop on nuclear structure of the zirconium region; Bad Honnef, F.R. Germany (24 Apr 1988).

Over the recent years the nuclear structure around the N = 50 shell closure, which is very pronounced in the strontium and zirconium isotopes, has been the subject of extensive experimental and theoretical work. On the proton side Z = 38 and Z = 40 provide fairly closed sub-shells. In the strontium isotopes the lg/sub 9/2/ neutron shell is closed at ^{88}Sr, supplying relatively pure neutron-hole and neutron-particle states with large spectroscopic factors in ^{87}Sr and ^{89}Sr, as well as core-coupled states. The mass region is thus ideally suited to examine the transition from a correlated to an uncorrelated (chaotic?) excitational behavior. These two types are characterized e.g. by the density of excited states, the transition strengths, and the spectroscopic factors observed in transfer reactions. We conducted (n,γ) and (d,p) reactions leading to /sup 87,88,89/Sr in addition to ^{88}Sr(d,t)^{87}Sr and 24 keV neutron capture in ^{88}Sr. The vast amounts of data were used to analyze the level densities and transition strengths in the statistical model. Correlations were found between the selective population of states dominating the (d,p) process, and the statistical decay of the compound state formed after thermal neutron capture. In the course of the analyses we established essentially complete level schemes (within limited spin windows centered around the spin of the capture state) up to around half the neutron binding energy. The E1 partial decay widths were found to agree with results of giant resonance calculations. We intend to give an overview of the experiments and outline the results of the model calculations. 24 refs., 4 figs.

41949 **(IPNO-DRE—87-26) Heavy-ion reactions and new trends of nuclear Physics.** Bernas, M. (Paris-11 Univ., 91 - Orsay (France). Inst. de Physique Nucleaire). Jun 1987. 16p. (CONF-8706234—). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88752427/JAW.

From International school of physics Enrico Fermi: course on trends in nuclear physics; Varenna, Italy (23 Jun 1987).

On the chart of the nuclei, there are still areas which would deserve to be explored like the Nickel hole on the neutron rich side. We shall illustrate here the progress recently accomplished along this line and compare resulting datas with Hartree Fock Bogoliubov (H.F.B.) calculations performed on those isotopes. It is shown how well-known production reactions like quasi elastic transfer or neutron induced fission have been pushed toward their limits, thanks to improvements in experimental devices, to be usable further apart from stability.

41950 **(IPNO-T—87-05) Contribution to form transition study by inelastic diffusion: application to even Samarium and Germanium isotopes.** Obiajunwa, E. (Paris-11 Univ., 91 - Orsay (France). Inst. de Physique Nucleaire; Paris-11 Univ., 91 - Orsay (France)). 10 Jul 1987. 116p. (In French). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88752443/JAW.

The stable even samarium and germanium isotopes have been studied by means of inelastic proton (E/sub p/=24 MeV) and alpha (E/sub α/ = 36 MeV) scattering. The various collective nuclear models: vibrations harmonic (VM) and anharmonic (AVM), rotational symmetric (SRM) and asymmetric (ARM), rotation-vibration (RVM), and interacting bosons model (IBM), used in the analysis of the experimental data are presented. The data for the low-lying levels of /sup 148,150/Sm are analysed in the framework of the second order VM. The multiple-phonon states (1/sup -/, 3/sup -/, 3/sup -/) are studied for the first time in these nuclei. The data for the low-lying members of the ground states band (0/sup +/, 2/sup +/, 4/sup +/, 6/sup +/) of /sup 152,154/Sm are analysed in the framework of SRM. The ground-state band and the octupole-vibrational band K/sup π/ = 0, (1/sup -/, 3/sup -/, 5/sup -/), of these two nuclei are for the first time, analysed simultaneous and in a coherent fashion, in the framework of the RVM. In the case of the inelastic /sup 70-74/Ge (α, α') experiments, the data for the low-lying states are analysed in the framework of the ARM, VM and AVM. The AVM is found to give a better description of the low-lying states of these three nuclei. A more rigorous and coherent method of treating the anharmonicity in vibrational nuclei is presented, starting from the Hamiltonian of Brink and Kerman; the results obtained by this method are very encouraging. The application of the IBM to the analysis of inelastic scattering data is presented.

41951 (ZfK—592, pp 181-183) **Measurement of the total proton emission cross section of neutron induced reaction on /sup 60/Ni at 18.5 MeV.** Korman, A.; Marianski, B.; Rodio, J.; Czerski, K. (Institute for Nuclear Studies, Otwock-Swierk (Poland)). Apr 1986. NTIS (US Sales Only), PC A09/MF A01. Order Number DE88780092/JAW. (CONF-8511312—).

From 15. international symposium on nuclear physics - nuclear fission; Gaussig, German D.R. (11 Nov 1985).

The total proton emission cross section of the /sup 60/Ni(n,p)/sup 60/Co reaction at 18.5 MeV as well as the angular distribution of protons from this reaction are measured. The obtained angle integrated proton spectrum is presented and compared with results of the combined pre-equilibrium hybrid model and multistage nuclear reaction Hauser-Feshbach calculations.

6517 Nuclear Properties And Reactions, A=90-149, Experimental

41952 **(CSIR-RR—661) Activity measurements of /sup 109/Cd: international comparison (March 1986).** Simpson, B.R.S.; Meyer, B.R. (Council for Scientific and Industrial Research, Pretoria (South Africa). National Accelerator Centre). 1988. 24p. National Accelerator Centre, P.O. Box 72, Faure, 7131, South Africa.

Participation in an international intercomparison of activity measurements of a /sup 109/Cd solution is described. The activity was measured using two methods, both based on liquid scintillation coincidence counting. The results of the NAC measurements are compared with those of the other laboratories who participated in the comparison.

41953 **(IPNO-T—87-07) Peripheral collisions of heavy ions induced by /sup 40/Ar at intermediate energies: giant resonance high energy structures and projectile fragmentation.** Blumenfeld, Y. (Paris-11 Univ., 91 - Orsay (France). Inst. de Physique Nucleaire). Sep 1987. 148p. (In French). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88754059/JAW.

The results obtained in similar studies at low incident energies are first of all reviewed. The time of flight spectrometer built for the experiments is then described. A study of the properties of

the projectile-like fragments shows numerous deviations from the relativistic energy fragmentation model. Evidence for a strong surface transfer reaction component is given and the persistence of mean field effects at intermediate energies is stressed. A calculation of the contribution of the transfer evaporation mechanism to the inelastic spectra shows that this mechanism is responible for the major part of the background measured at high excitation energy and can in some cases induce narrow structures in the spectra. The inelastic spectra shows a strong excitation of the giant quadrupole resonance. In the region between 20 and 80 MeV excitation energy narrow structures are present for all the studied systems. Statistical and Fourier analysises allow to quantify the probabilities of existence, the widths and the excitation energies of these structures. A transfer evaporation hypothesis cannot consistently reproduce all the observed structures. The excitation energies of the structures can be well described by phenomenological laws where the energies are proportional to the -1/3 power of the target mass. Complete calculations of the excitation probabilities of giant resonances and multiphonon states are performed within a model where the nuclear excitation are calculated microscopically in the Random Phase Approximation. It is shown that a possible interpretation of the structures is the excitation of multiphonon states built with 2/ sup +/ giant resonances.

41954 **(ISN—87-74) Peripheral collisions in the reaction /sup 40/Ar + /sup 93/Nb at 27.5 MeV/nucleon.** Pastel, R. (Grenoble-1 Univ., 38 (France). Inst. des Sciences Nucleaires). Sep 1987. 62p. (In French). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88754060/JAW.

This thesis describes an experimental study of the reaction / sup 40/Ar + /sup 93/Nb at 27.5 MeV/nucleon carried out at the GANIL accelerator. Reaction products were detected in a large position sensitive localization ionization chamber. The experimental data were used to obtain information concerning the reaction mechanism especially for peripheral collisions. A model using the properties of random works were applied successfully to the interpretation of the data. The importance of the deflection produced by the ion-ion potential as well as of the emission of alpha particles in the reaction is stressed.

41955 **(JINR-R—3-87-43) Study of parity nonconservation in neutron resonances of /sup 93/Nb,/sup 113/Cd, /sup 141/Pr.** Alfimenkov, V.P.; Borzakov, S.B.; Mareev, Yu.D.; Pikel'ner, L.B.; Khrykin, A.S.; Sharapov, Eh.I. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics). 1987. 6p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88703401/JAW.

Experimental study of pairity nonconservation in p-wave neutron resonances of /sup 93/Nbm /sup 113/Cd, /sup 141/Pr is described. The measurements were performed on the beam of polarized neutrons from the IBR-30 pulsed reactor (Dubna). The paper contains experimental estimates for the asymmetry parameters of the total cross section in the resonance region and for the matrix elements of the mixing s- and p-levels of compound nuclei. 13 refs.; 2 figs.; 2 tabs.

41956 **(JINR-R—15-87-529) Investigation of alphaspectra of the /sup 149/Sm(n,α)/sup 146/Nd reaction at 2 keV neutron energy.** Andrzejewski, J.; Vo Kim Thanh; Vtyurin, V.A.; Le Bang Shiong; Vertebnyj, V.P.; Kirilyuk, A.L. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics; AN Ukrainskoj SSR, Kiev. Inst. Yadernykh Issledovanij). (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics; AN Ukrainskoj SSR, Kiev. Inst. Yadernykh Issledovanij). 1987. 5p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88703421/JAW.

Alpha spectra of the /sup 149/Sm(n, a)/sup 146/Nd reaction were measured at a neutron energy of 2 keV achieved using the Sc-filter on WWR-M-Kiev reactor beam. The alpha spectra to the first excited and ground states of the daughter /sup 146/Nd nucleus as well as the ratio of reduced α-widths of these transition equal to 0.88-0.24 are obtained. The averaged cross section of the reaction has been more precisely measured. It is equal to (17.9 +- 3.6) μb. 8 refs.; 3 figs.; 2 tabs.

41957 **(ORNL/TM—10766) Search for ^{136}Xe resonance neutron capture.** Macklin, R.L. (Oak Ridge National Lab., TN (USA)). May 1988. Contract AC05-84OR21400. 15p. NTIS, PC A03/MF A01; GPO Dep. Order Number DE88008588/JAW.

Evidence for neutron capture in ^{134}Xe at 2154-eV and 18.4-keV resonances is presented and quantified in terms of limits on Breit-Wigner single level parameters. Assuming the radiation width, 32 meV, found at the 18.4-keV resonance for all the reported resonances at higher energies, the Maxwellian average capture cross section is calculated for a range of stellar interior temperatures T. For kT = 30 keV only 0.72 mb is found. Only one third of this comes from the resonances above 18.4 keV so an overall uncertainty at kT = 30 keV of {+-}0.11 mb at the 68% probability level seems reasonable. Four resonances in ^{134}Xe were also found. 11 refs., 5 figs.

41958 (ZfK—592, pp 74-77) **Temperature shift of neutron resonances.** Ignatovich, V.K.; Meister, A.; Mittag, S.; Pilz, W.; Seeliger, D.; Seidel, K. (Technische Univ., Dresden (German Democratic Republic); Joint Inst. for Nuclear Research, Dubna (USSR)). Apr 1986. NTIS (US Sales Only), PC A09/MF A01. Order Number DE88780092/JAW. (CONF-8511312—).

From 15. international symposium on nuclear physics - nuclear fission; Gaussig, German D.R. (11 Nov 1985).

Temperature induced shifts of neutron resonances has been experimentally observed studying low-energy resonances of Rh-103, Ag-109, Dy-161 and Dy-163 with a time-of-flight spectrometer at the Dubna pulsed reactor. The shifts observed for the first time, are regarded as an analogue to the second-order Doppler effect in Moessbauer γ-ray spectroscopy.

6518 Nuclear Properties And Reactions, A=150-189, Experimental

41959 **Photon production cross section for /sup 181/ta.** Ramakrishnan, P.; Mitchell, G.E.; Gould, C.R.; Wender, S.A.; Auchampaugh, G.F. (North Carolina State Univ., Raleigh, NC (US)). *Nuclear Science and Engineering:* **98**: No. 4, 348-356(Apr 1988).

The /sup 181/Ta(n,chiγ) reaction has been measured for neutron energies E/sub n/ = 2 to 100 MeV and for gamma-ray energies E/sub γ/ = 2 to 25 MeV using an array of bismuth germane detector and the pulsed neutron source at the Los Alamos Meson Physics Facility. The integrated photon production cross section reaches a maximum at —7.5 MeV. Above 20 MeV, the cross section increases slowly with energy. The angular distributions of the photon production cross sections for the different neutron energies are isotropic. At all measured neutron energies the gamma-ray spectra have the simple evaporation form.

6519 Nuclear Properties And Reactions, A=190-219, Experimental

41960 **(BNL—41155) Projectile energy degradation at 14.5 GeV/u.** Duek, E.; Abbott, T.; Akiba, Y.; Alburger, D.; Beavis, D.; Betts, R.R.; Bloomer, M.A.; Bond, P.D.; Chasman, C.; Chu, Y.Y.; Cole, B.A.; Costales, J.B.; Crawford, H.J.; Cumming, J.B.; Debbe, R.; Enge, H.A.; Engelage, J.; Fung, S.Y.; Greiner, D.; Grodzins, L.; Gushue, S.; Hamagaki, H.; Hansen, O.; Haustein, P.; Hayashi, S.; Homma, S.; Huang, H.Z.; Ikeda, Y.; Katcoff, S.; Kaufman, S.; Ledoux, R.J.; Levine, M.J.; Lindstrom, P.; Mariscotti, M.A.J.; Miake, Y.; Morse, R.J.; Nagamiya, S.; Olness, J.; Parsons, C.G.; Remsberg, L.P.; Sarabura, M.; Shor, A.; Steadman, S.G.; Stephans, G.S.F.; Sugitate, T.; Sunyar, A.W.; Tanaka, M.; Tannenbaum, M.J.; Torikoshi, M.; Van Dijk, J.H.; Videbaek, F.; Vincent, P.; Vulgaris, E.; Vutsadakis, V.; Watson, W.A. III; Wegner, H.E.; Woodruff, D.S.; Zajc, W. (JSPS Fellowship for Japanese Junior Scientists). 1988. Contract AC02-76CH00016. 4p. (CONF-8806117—1). NTIS, PC A02. Order Number DE88009849/JAW.

From 3. international conference on nucleus nucleus collisions; Saint-Malo, France (6 Jun 1988).

The generation of states of high energy density hinges on the question of nuclear stopping or, in other words, on the rapidity lost by the projectile as it ploughs through the target. Recent data have shown [1-2] that, at 10 and 14.5 GeV/u, the total neutral (E°/sub TOT/) and transverse energy (ET) distributions can be used to infer complete stopping, as measured by the inability of targets heavier than Cu to yield additional neutral energy. An alternative measurement of projectile stopping would rely on the absence of significant residual projectile energy along its direction of motion. We present experimental evidence showing that the flow of forward energy is a valuable probe of nuclear stopping and that, at 14.5 GeV/u, the projectile energy is completely degraded for central collisions in heavy targets. The forward energy observed is shown to be adequately reproduced by simple geometrical calculations. The correlation of the forward energy with E°/sub TOT/, will be shown to provide information on the number of projectile participant nucleons. 5 refs., 2 figs.

41961 **(GANIL-P—87-25) Possible dynamical limitations to excitation energy storage in nuclei.** Saint-Laurent, F.; Kyanowski, A.; Ardouin, D.; Delagrange, H.; Doubre, H.; Gregoire, C.; Mittig, W.; Peghaire, A.; Peter, J.; Viyogi, Y.P. (Grand Accelerateur National d'Ions Lourds (GANIL), 14 - Caen (France)). 1987. 10p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88753968/JAW.

The dependence of the relative populations of particle unbound states on the associated charged particle multiplicity and on the total kinetic energy of the two decay products was investigated for /sup 40/Ar induced reactions on /sup 197/Au at E/A=60 MeV. The measurements indicate that the relative populations exhibit little sensitivity to the violence of the collision and to the time of emission. Implications of these results upon the dynamics of the reaction are discussed.

41962 **(INIS-BR—959) Contribution to the study of Pt/sup 197/ and Au/sup 197/ excited states.** Alves, S.M.C. (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro). 1971. 82p. (In Portuguese). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88701613/JAW.

The gamma transitions of the Ir/sup 197β-/-> Pt/sup 197β-/-> Au/sup 197/ decay chain were investigated using three Ge(Li) detectors of high resolution and spectroscopy techniques with one, two and three via of analysis. For the Ir/sup 197β-/->Pt/sup 197/ decay, four new gamma transitions with energy of 877.6; 938.7; 1049.6 and 1341.8 Kev were observed, presupposing to be energy levels in 877.6; 938.7; 1049.6 and 1347.8 Kev in the Ir/sup 197/ population by/sup β-/ decay of Ir/sup 197/. By the first time, the 299.5 Kev transition was observed, in the Pt/sup 197/m (80min) decay, interpreted as a direct desexcitation of the 299.5Kev level in Pt/sup 197/. A new scheme of Ir/sup 197/ /sup β-/-> Au/sup 197/ decay based on the obtained results, is proposed. (M.C.K.).

41963 **(ISN—87-65) Study of nucleus-nucleus interaction from elastic and inelastic scattering of ^{12}C ions at intermediate energies.** Hostachy, J.Y. (Grenoble-1 Univ., 38 (France). Inst. des Sciences Nucleaires). 22 Jun 1987. 173p. (In French). NTIS (US Sales Only), PC A08/MF A01. Order Number DE88752442/JAW.

The elastic and inelastic scattering angular distributions of /sup 12/C on the targets /sup 12/C and /sup 208/Pb have been measured at the Laboratoire National Saturne (Saclay) using the spectrometer SPES 1. The data have been analysed in the framework of the optical model with Woods-Saxon potentials. A near side/far side decomposition of the cross-section has provided a more detailed insight into the refraction effects. These analysises show that the strong absorption radius, the reaction cross-section, and consequently the absorption in the surface region, decrease when the incident energy increases, allowing to probe the inner part of the ion-ion potential. The transparency region extends down to a radial internuclei distance of about 3 fm for the /sup 12/C - /sup 12/C system and 8 fm for the /sup 12/C - /sup 208/Pb system. The onset of a decrease of the imaginary potential has been deduced for the two systems. The real potential is also decreasing, but much more rapidly for the /sup 12/C - /sup 208/Pb system than for /sup 12/C- /sup 12/C. We have also developed a microscopic approach in the optical limit of the Glauber theory, including the Pauli-blocking, the Fermi motion and the nucleus finite size effects. For the intermediate energies, the calculations are in fair agreement with the experimental data.

41964 **(JINR—R-7-86-322, pp 38) Nucleus ternary fission with /sup 4/He emission in the /sup 16/O(144 MeV) + /sup 232/Th and /sup 12/C(108 MeV) + Au reactions.** Sovinski, M.; Levitovich, M.; Kupchak, R.; Yankovski, A.; Skobelev, N.K.; Khojnatski, S. 1986. (In Russian). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88780065/JAW.

In Heavy ion physics - 1985. Collection of annotations of the Nuclear Reaction Laboratory of the Joint Nuclear Research Institute works, 1985.

41965 **(LPCC-T—87-02) Study of reaction mechanisms observed in the Kr+Au system at 35 and 44 MeV by nucleon.** Colin, J. (Caen Univ., 14 (France). Lab. de Physique Corpusculaire). Nov 1987. 63p. (In French). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88753973/JAW.

In this experiment performed at GANIL, the study of the reactions mechanisms which appear in the interaction Kr+Au at 35 and 44 MeV/u, is based on the correlations analysis between the heavy fragments produced. The use of the first available modulus of XYZT and DELF multidetectors allowed the observation of a significant population of three fold coincidence events (one forward fragment in XYZT (3/sup 0/, 30/sup 0/) and two fragments in DELF (+- 45/sup 0/, +-110/sup 0/)). The velocity characteristics of the forward fragment enable one to separate two classes of events: First, coincidences between a projectile residue detected in XYZT and two target fragments in DELF. For these events, a study of incomplete linear momentum transfer leads to a transfer rate smaller than 20 %. The different kinetic observables are then correctly reproduced by an abrasion-ablation model. Then, coincidences between three fragments that appear to come from only one source. The fragment's characteristics are compatible with a cracking mechanism of the target. The reaction mechanisms observed do not seem to be directly dependent on the projectile velocity but rather on the projectile energy.

6520 Nuclear Properties And Reactions, A=220 And Above, Experimental

41966 **(CENBG—8712) Mass - kinetic energy - nuclear charge correlation study of fragments produced in thermal fission of /sup 239/Pu.** Riahi, A. (Bordeaux-1 Univ., 33 - Gradignan (France). Centre d'Etudes Nucleaires). Jul 1987. 99p. (In French). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88754052/JAW.

This work is devoted to the measurement of fission fragment mass, nuclear charge and kinetic energy distribution and to the different correlations between these quantities for /sup 239/Pu thermal neutron induced fission. Fission fragments are identified using the COSI FAN TUTTE spectrometer installed near the High Flux reactor at the Laue Langevin Institute in Grenoble. The present results confirm the one previously obtained using the Lohengrin mass spectrometer which they extend to higher kinetic energies. The results are analysed within the framework of the Wilkins scission point model; they clearly show the major influence of nascent fragments shell effects on the fragmentation of the fissioning nucleus and the existence of a weak (9%) even-odd effect on the protons sharing between the two fragments.

41967 **(GANIL-P—87-20) Linear momentum transfer in pion accompanied ^{16}O induced reaction on ^{232}Th at 95 MeV per nucleon.** Bolore, M.; Cassagnou, Y.; Dabrowski, H.; Le Brun, C.; Lecolley, J.F.; Louvel, M.; Erazmus, B.; Guet, C.; McGrath, R. (Grand Accelerateur National d'Ions Lourds (GANIL), 14 - Caen (France)). 1987. 25p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88752436/JAW.

Positive pions and protons emitted at 90/sup 0/ were measured in coincidence with two fission fragments in the reaction /sup 16/0 + /sup 232/Th at 95 MeV/nucleon. The linear momentum transfer distribution has been determined from the folding angle between the fragments. The average momentum transfer is 2.5 GeV/c +- 0.2 GeV/c for a pionic reaction. An analysis in terms of impact parameter distributions leads to the conclusion that subthreshold pion production requires a large overlap of projectile and target density profiles.

41968 (JINR—R-7-86-322, pp 14) **Measurement of half-life (T1/2) of short-lived spontaneously fissile nuclide from the /sup 249/Bk + /sup 15/N reaction.** Ter-Akop'yan, G.M.; Sagajdak, R.N.; Pleve, A.A.; Tret'yakova, S.P.; Buklanov, G.V.; Artyukh, A.G.; Kalinin, A.M. 1986. (In Russian). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88780065/JAW.

In Heavy ion physics - 1985. Collection of annotations of the Nuclear Reaction Laboratory of the Joint Nuclear Research Institute works, 1985.

41969 (NEACRP—302-L) **Data for decay Heat Predictions. Proceedings of a specialists' meeting.** (Nuclear Energy Agency, 75 - Paris (France)). 1987. 386p. (NEANDC—245-U; CONF-8709122—). NTIS (US Sales Only), PC A17/MF A01. Order Number DE88753592/JAW.

From Specialists' meeting on data for decay heat predictions; Studsvik, Sweden (7 Sep 1987).

These proceedings of a specialists' meeting on data for decay heat predictions are based on fission products yields, on delayed neutrons and on comparative evaluations on evaluated and experimental data for thermal and fast fission. Fourteen conferences were analysed.

41970 (NEACRP—302-L, pp 9-19) **Nuclear-charge distribution and delayed-neutron yields for thermal-neutron-induced fission of /sup 235/U, /sup 233/U, /sup 239/Pu, and /sup 241/Pu and for fast-neutron-induced fission of /sup 238/U.** Wahl, A.C. (Washington Univ., Saint-Louis, MO (US)). 1987. NTIS (US Sales Only), PC A17/MF A01. Order Number DE88753592/JAW. (NEANDC—245-U; CONF-8709122—).

From Specialists' meeting on data for decay heat predictions; Studsvik, Sweden (7 Sep 1987).

Data concerning nuclear-charge distribution in fission are evaluated for thermal-neutron-induced fission of /sup 235/U, /sup 233/U, /sup 239/Pu and /sup 241/Pu and for fast-neutron-induced fission of /sup 238/U. Parameters for the Zp and A'p empirical models are derived from the evaluated data, and yields calculated from the models are compared with experimental data. Estimates of uncertainties in the calculated yields are deduced from the results of the comparisons. Evaluated experimental independent yields and errors are supplemented by values estimated from the models, and the combined yield sets are normalized to achieve mass and charge balance. The normalized complete independent-yields sets are used to derive element yields, Y(Z), yields for each neutron number, Y(N) and delayed-neutron yields, which require delayed-neutron-emission probabilities, Pn, from another source. Results of decay-heat calculations with the new yield sets for thermal-neutrons-induced fission of /sup 235/U and /sup 239/Pu are compared to those made with ENDF/B-V yield sets and to the ANS5.1 USA standards.

41971 (NEACRP—302-L, pp 21-36) **Evaluation of fission product yields for the USA National Nuclear Data files.** Rider, B.F.; England, T.R. (Los Alamos National Lab., NM (US)). 1987. NTIS (US Sales Only), PC A17/MF A01. Order Number DE88753592/JAW. (NEANDC—245-U; CONF-8709122—).

From Specialists' meeting on data for decay heat predictions; Studsvik, Sweden (7 Sep 1987).

Accurate knowledge of fission product decay heat is an important input to the design of quality emergency core-cooling systems for nuclear power plants. An evaluated set of fission product yields for use in calculation of decay heat curves with improved accuracy have been prepared. These evaluated yields are based on all known experimental data through 1986. Unmeasured fission product yields are calculated from charge distribution, pairing effects, and isomeric state models developed at Los Alamos National Laboratory. The current evaluation will serve as a preliminary set of fission product yields for ENDF/B-VI.

41972 (NEACRP—302-L, pp 37-68) **Evaluation of fission product yields.** Dao, W.; Dongming, Z. (Academia Sinica, Beijing, BJ (CN). Inst. of Atomic Energy). 1987. NTIS (US Sales Only), PC A17/MF A01. Order Number DE88753592/JAW. (NEANDC—245-U; CONF-8709122—).

From Specialists' meeting on data for decay heat predictions; Studsvik, Sweden (7 Sep 1987).

A preliminary fission product yield library has been set up. At present, it contains 10 fissioning systems: U235T, U235F, U235HE, U238F, U238HE, Pu239T, Pu239F, Pu241T, U233T and Th232F, each of them involves 1170 fission product nuclides. For every one of the nuclides, both independent and cumulative yields together with their uncertainties are given. The 10 sets of yield recommended values are compiled in two formats: one, ENDF/B-V; the other, legible form. This paper will summarize the evaluation procedure, and present some resultants compared with ENDF/B-VE yields.

41973 (NEACRP—302-L, pp 69-106) **Review of libraries of fission product yields.** James, M.F. (UKAEA Atomic Energy Establishment, Winfrith (UK)). 1987. NTIS (US Sales Only), PC A17/MF A01. Order Number DE88753592/JAW. (NEANDC—245-U; CONF-8709122—).

From Specialists' meeting on data for decay heat predictions; Studsvik, Sweden (7 Sep 1987).

Several libraries of fission product yields are in use internationally. This paper summarizes and compares Chinese, French, UK and US libraries. These, being in the same format, can be quite readily compared. The different methods and philosophies of evaluation are reviewed, especially as they affect the recommended uncertainties. Detailed comparisons of the libraries are presented, and some of the larger differences studied in depth. The effects of any discrepancies on decay heat calculations are discussed. It is also noted that differences in uncertainties in yield data lead to some differences in uncertainties in summation calculations. There is great advantage in maintaining at least two independent yield libraries, and it is hoped that the libraries described will be continually improved and updated. Suggestions for improvements in evaluation methods, and for collaboration at various pre-evaluation stages are made.

41974 (NEACRP—302-L, pp 107-118) **Review of nuclear data of relevance for the decay heat problem.** Reich, C.W. (Idaho National Engineering Lab., Idaho Falls (US)). 1987. NTIS (US Sales Only), PC A17/MF A01. Order Number DE88753592/JAW. (NEANDC—245-U; CONF-8709122—).

From Specialists' meeting on data for decay heat predictions; Studsvik, Sweden (7 Sep 1987).

The decay data (T1/2, Q/sub β/, <E/sub β/> and <E/sub γ/>) for fission-product nuclides are reviewed, with emphasis on those nuclides important for decay-heat calculations in the region from ~ 10 sec to ~ 10/sup 3/ sec. Problems involved in deducing <E/sub β/> and <E/sub γ/> values for these, and hence for even more neutron-rich, nuclides are illustrated by the example of /sup 87/Br.

41975 (NEACRP—302-L, pp 119-140) **Decay data for decay heat predictions.** Blachot, J.; Duchemin, B.; Nimal, B. (CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France). Dept. de Recherche Fondamentale; CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Inst. de Recherche Technologique et de Developpement Industriel (IRDI)). 1987. NTIS (US Sales Only), PC A17/MF A01. Order Number DE88753592/JAW. (NEANDC—245-U; CONF-8709122—).

From Specialists' meeting on data for decay heat predictions; Studsvik, Sweden (7 Sep 1987).

The main source of data for the decay heat prediction is now coming from ENSDF. The total decay energy, the half lives, the beta and gamma branching and the average values are generally present in ENSDF, when they have been measured. But the main objective of ENSDF is to describe the nuclear structure properties. The average values are sometimes missing and never estimated. We'll review, all we can find in ENSDF as data for decay heat predictions. Their systematic analysis can be a solution to estimate average energies, when no measurement is available. Average energies are also measured using a spectrometer. A comparison between data in ENSDF and results from direct measurement will be done. Theoretical models can also predict the decay data properties.

41976 (NEACRP—302-L, pp 141-152) **Average decay energies in JNDC file version 2.** Katakura, J.; Nakasima, R. (Japan Atomic Energy Research Inst., Tokai, Ibaraki. Tokai Research Establishment; Hosei Univ., Tokyo (JP). Dept. of Physics). 1987. NTIS (US Sales Only), PC A17/MF A01. Order Number DE88753592/JAW. (NEANDC—245-U; CONF-8709122—).

From Specialists' meeting on data for decay heat predictions; Studsvik, Sweden (7 Sep 1987).

The first version of JNDC FP Nuclear Data File has been released in 1981 by Working Group on Evaluation in the Japanese Nuclear Data Committee. This first version has been successfully applied to decay heat calculation of important fissionable nuclides. After the release of the first version, the working group has continued the evaluation work of the decay data focussing an attention on the average decay energies. The compilation work of the second version is now on the almost final stage. In this paper, the average decay energies in the second version and the comparison of them with the other data will be described.

41977 (NEACRP—302-L, pp 153-174) **Average beta energies of fission products and their use for decay heat predictions.** Rudstam, G.; Aleklett, K.; Lund, E. (Uppsala Univ., Nykoeping (SE). Studsvik Neutron Research Lab). 1987. NTIS (US Sales Only), PC A17/MF A01. Order Number DE88753592/JAW. (NEANDC—245-U; CONF-8709122—).

From Specialists' meeting on data for decay heat predictions; Studsvik, Sweden (7 Sep 1987).

Average beta energies have been determined for 112 fission products by direct beta measurements. The results have also been combined with total disintegration energies and delayed-neutron data for an evaluation of the corresponding average gamma energies. The measured set of nuclides contributes the major part of the decay heat in nuclear fuel at short cooling times.

41978 (NEACRP—302-L, pp 175-186) **Assessment of fission product data for decay power calculation in fast reactors.** Sridharan, M.S.; Murthy, K.P.N. (Indira Gandhi Centre for Atomic Research, Kalpakkam (IN)). 1987. NTIS (US Sales Only), PC A17/MF A01. Order Number DE88753592/JAW. (NEANDC—245-U; CONF-8709122—).

From Specialists' meeting on data for decay heat predictions; Studsvik, Sweden (7 Sep 1987).

A review of our present capability at IGC, Kalpakkam to predict fission product decay power in fast reactors is presented. This is accomplished by comparing our summation calculations with the calculations of others and the reported experimental measurements. Our calculations are based on Chandy code developed at our Centre. The fission product data base of Chandy is essentially drawn from the yield data compiled by Crouch (1977) and the data on halflives etc. compiled by Tobias (1973). In general, we find good agreement amongst the different calculations (within +-5%) and our calculations also compare well with experimental measurements of AKIAMA et al and MURPHY et al..

41979 (NEACRP—302-L, pp 187-198) **Delayed-neutrons: a summary of the Birmingham meeting in September 1986, and new developments.** Weaver, D.R. (Birmingham Univ. (UK). Dept. of Physics). 1987. NTIS (US Sales Only), PC A17/MF A01. Order Number DE88753592/JAW. (NEANDC—245-U; CONF-8709122—).

From Specialists' meeting on data for decay heat predictions; Studsvik, Sweden (7 Sep 1987).

The information on the properties of delayed neutrons which was presented at the Specialists' meeting at the University of Birmingham in September 1986 is reviewed together with comments on more recent developments.

41980 (NEACRP—302-L, pp 199-210) **Review of new integral determinations of decay heat.** Dickens, J.K. (Oak Ridge National Lab., TN (US)). 1987. NTIS (US Sales Only), PC A17/MF A01. Order Number DE88753592/JAW. (NEANDC—245-U; CONF-8709122—).

From Specialists' meeting on data for decay heat predictions; Studsvik, Sweden (7 Sep 1987).

Over a decade ago, concern over possible serious consequences of a loss-of-coolant accident in a commercial light-water reactor prompted support in several countries of several experiments designed specifically to measure the decay heat of beta-ray and gamma-ray emanations from fission products for thermal reactors. In 1979, a new standard for use in computing decay heat in real reactor environs (for example, for regulatory requirements) was approved by the American Nuclear Society. Since then there have been additional experimental measurements, in particular for fission induced by fast neutrons. In addition, the need for decay-heat data has been extended well beyond the time regime of a loss-of-coolant accident. The efficacy of the 1979 ANS standard has been a subject of study with generally positive results. However, a specific problem, namely, the consequences for decay heat of fission-product neutron capture merits further experimental study.

41981 (NEACRP—302-L, pp 211-223) **Integral determination of the beta and gamma heat in thermal-neutron-induced fission of /sup 235/U and /sup 239/Pu, and of the gamma heat in fast fission of /sup 238/U.** Johansson, P.I. (Uppsala Univ., Nykoeping (SE). Studsvik Neutron Research Lab.). 1987. NTIS (US Sales Only), PC A17/MF A01. Order Number DE88753592/JAW. (NEANDC—245-U; CONF-8709122—).

From Specialists' meeting on data for decay heat predictions; Studsvik, Sweden (7 Sep 1987).

Decay γ- and β-energy release rates for thermal neutron fission of /sup 235/U and /sup 239/Pu and the γ-energy release rates from /sup 238/U for neutrons of 2.3 MeV have been measured by integral measurement. Absolute values have been obtained for the /sup 235/U γ-energy over the time range 10 s to 1500 s and β-energy from 10 s to 10/sup 4/ s and for /sup 239/Pu β-energy from 10 s to 10/sup 4/ s cooling time. Relative values are given for /sup 239/Pu (10 s to 10/sup 4/ s) and for /sup 238/U decay γ-energy (10 s to 10/sup 4/ s). The accuracy of the data is better than 7% and the agreement with data from Oak Ridge is very good except for /sup 235/U decay γ-energy.

41982 (NEACRP—302-L, pp 225-265) **Uncertainties in JEF1 Integral decay heat predictions estimated from comparisons with a least squares fit to measured data.** Tobias, A. (Central Electricity Generating Board, Berkeley (UK). Berkeley Nuclear Lab.). 1987. NTIS (US Sales Only), PC A17/MF A01. Order Number DE88753592/JAW. (NEANDC—245-U; CONF-8709122—).

From Specialists' meeting on data for decay heat predictions; Studsvik, Sweden (7 Sep 1987).

Systematic and random uncertainties in JEF1 decay heat predictions for both U235 and Pu239 have been quantified from comparisons with benchmarks derived from least squares fits to measured data. The lack of reliable decay data for short lived nuclides results in systematic errors in JEF1 (and other summation) predictions of typically up 8.5% at short cooling times. This decreases with cooling time and becomes negligible at times exceeding 1.0E4 s. Corresponding random uncertainties derived from the least squares fits were increased to reflect outstanding and unresolved discrepancies in measured data. Uncertainties in capture contributions were also examined briefly in order to estimate the uncertainty in JEF1 integral decay heat predictions for most practical applications. Best estimate decay heat predictions may be derived from corresponding JEF1 values via the systematic factors determined in the present work while upper bound values, required for

certain applications, may be obtained by applying a factor equal to the sum of the systematic error plus two standard deviations. It is concluded that further decay heat measurements, for Pu239 in particular, are required in order to resolve outstanding discrepancies between different sets of measurements. Extension of measurements to longer cooling times for both U235 and Pu239 is desirable in order to establish improved confidence in decay heat evaluation for practical applications.

41983 (NEACRP—302-L, pp 267-276) **French studies for improvement of the decay heat due to fission products.** Duchemin, B.; Chouha, M.; Blachot, J. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Dept. d'Etudes Mecaniques et Thermiques; Societe Franco-Americaine de Constructions Atomiques (FRAMATOME), 69 - Lyon (FR); CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France). Dept. de Recherche Fondamentale). 1987. NTIS (US Sales Only), PC A17/MF A01. Order Number DE88753592/JAW. (NEANDC—245-U; CONF-8709122—).

From Specialists' meeting on data for decay heat predictions; Studsvik, Sweden (7 Sep 1987).

Beta and gamma mean energy contributions to decay heat are revised in two cooling time regions. For short cooling time ($t<200$ sec) a methodology based on the statistical model is used to take account of the upper unknown levels. For medium cooling time ($200 < t < 2000$ sec.) a comparison between several data banks is undertaken for the most contributing nuclides. The result shows the interest of the methodology developed and the need for some more experimental results.

41984 (NEACRP—302-L, pp 277-288) **JNDC FP nuclear data file version 2 and its assessment.** Tasaka, K.; Katakura, J.; Yoshida, T. (Japan Atomic Energy Research Inst., Tokai, Ibaraki. Tokai Research Establishment; NAIG Nuclear Research Lab., Ukishima Kawasaki (JP)). 1987. NTIS (US Sales Only), PC A17/MF A01. Order Number DE88753592/JAW. (NEANDC—245-U; CONF-8709122—).

From Specialists' meeting on data for decay heat predictions; Studsvik, Sweden (7 Sep 1987).

The second version of the JNDC (Japanese Nuclear Data Committee) FP Nuclear Data File has been completed and assessment of the file has been carried out for the calculation of the FP decay power. The new data file is inclusive of evaluated decay, yield and neutron cross-section data, for 1230 FP nuclides. The theoretical and the experimental values of the average beta and gamma decay energies have been thoroughly reexamined for each nuclide, and the best values or most reliable ones have been chosen for inclusion into the new version. The comparison of the decay power curves calculated with the new version and the measured data at the University of Tokyo and at Oak Ridge National Laboratory for variety of fissiles from /sup 232/Th to /sup 241/Pu shows clear improvement in agreement especially around 1000 s and also after 1000 s.

41985 (NEACRP—302-L, pp 289-301) **Calculation of sensitivities of nuclide inventories and decay power.** James, M.F. (UKAEA Atomic Energy Establishment, Winfrith (UK)). 1987. NTIS (US Sales Only), PC A17/MF A01. Order Number DE88753592/JAW. (NEANDC—245-U; CONF-8709122—).

From Specialists' meeting on data for decay heat predictions; Studsvik, Sweden (7 Sep 1987).

Several computer codes are available for calculating inventories of actinides, activation products, and fission products during and after an irradiation. FISPIN(1) is the program most used in the UK for this purpose. Here we describe one method by which inventory codes may be modified so that they can also calculate the sensitivities of these inventories to small changes in all or some of the input data (half-lives, cross sections, fission yields, etc.). The sensitivities are needed as indicators of the most critical items of input data, and in the calculation of uncertainties of the inventories and of derived quantities such as decay heat. This latter step of course requires the inclusion of uncertainties and correlations in the input data: this process has begun with current libraries, but is by no means sufficiently complete.

41986 (ZfK—592, pp 18-24) **Simultaneous investigation of fission fragments and neutrons in /sup 252/Cf(s,f).** Budtz-Joergensen, C.; Knitter, H.H. (Commission of the European Communities, Geel (Belgium). Central Bureau for Nuclear Measurements). Apr 1986. NTIS (US Sales Only), PC A09/MF A01. Order Number DE88780092/JAW. (CONF-8511312—).

From 15. international symposium on nuclear physics - nuclear fission; Gaussig, German D.R. (11 Nov 1985).

The gridded twin ion chamber developed at CBNM is used to measure the kinetic energy-, mass- and angular distributions of the fission fragments of /sup 252/Cf in an advantageous 4π-geometry. Together with a neutron time-of-flight detector this experimental arrangement permits to measure the correlation between neutron emission, fragment angle, mass and energy in the spontaneous fission of /sup 252/Cf. With the present experimental set-up a mass resolution for fission fragments of 0.5 a.m.u., an angular resolution of $\Delta\cos\theta = 0.05$ and a timing resolution of 0.7 ns FWHM were observed. Preliminary evaluations of the raw experimental data are presented for the fission fragment mass distribution, the average total kinetic energy and their variance as function of mass, the angular distribution between fragments and neutrons, the number of neutrons emitted per fragment as function of fragment mass, the average neutron emission energies as function of mass, and the prompt fission neutron spectrum averaged over all fragments.

41987 (ZfK—592, pp 25-28) **Experimental study of correlations of energy and angular distributions of Cf-252 spontaneous fission neutrons.** Batenkov, O.I.; Blinov, A.B.; Blinov, M.V.; Smirnov, S.N. (Radievyj Inst., Leningrad (USSR)). Apr 1986. NTIS (US Sales Only), PC A09/MF A01. Order Number DE88780092/JAW. (CONF-8511312—).

From 15. international symposium on nuclear physics - nuclear fission; Gaussig, German D.R. (11 Nov 1985).

The measurements of differential energy distributions of Cf-252 fission prompt neutrons have been carried out for different emission angles.

41988 (ZfK—592, pp 29-34) **Study of the relationship between the characteristics of mass, energy, and neutron multiplicity distributions at the /sup 252/Cf spontaneous fission.** Alkhazov, I.D.; Dmitriev, V.D.; Kuznetsov, A.V.; Kovalenko, S.S.; Petrzhak, K.A.; Petrov, B.F.; Malkin, L.Z.; Shpakov, V.I. (Radievyj Inst., Leningrad (USSR)). Apr 1986. NTIS (US Sales Only), PC A09/MF A01. Order Number DE88780092/JAW. (CONF-8511312—).

From 15. international symposium on nuclear physics - nuclear fission; Gaussig, German D.R. (11 Nov 1985).

The main purpose of this work was to study relationships between the characteristics of energy and mass distributions of the /sup 252/Cf spontaneous fission fragments and those of prompt neutron multiplicity distribuitons.

41989 (ZfK—592, pp 35-38) **Low mass fragments from /sup 252/Cf spontaneous fission.** Ortlepp, H.G.; Kotte, R.; Stary, F. Apr 1986. NTIS (US Sales Only), PC A09/MF A01. Order Number DE88780092/JAW. (CONF-8511312—).

From 15. international symposium on nuclear physics - nuclear fission; Gaussig, German D.R. (11 Nov 1985).

An experimental arrangement for the investigation of light charged particles from ternary fission or for searching for superasymmetric binary fission products is presented. Using a time-of-flight/energy spectrometer low mass fission products were looked for in the /sup 252/Cf spontaneous fission. For the expected most probable superasymmetric fission fragment /sup 48/Ca an upper limit for the superasymmetric decay branch relative to alpha emission was deduced. Measured distributions of light products with masses around A = 13, A = 18 and A = 31 and with yields of Y = 10/sup -5/, Y = 1.5 center dot 10/sup -5/ and Y 3 center dot 10/sup -6/ respectively, were ascribed to ternary fission.

41990 (ZfK—592, pp 39-42) **Experimental arrangement for the measurement of correlations between fission products and neutrons.** Fromm, W.D.; Neubert, W.; Maerten, H.; Richter, D.; Seeliger, D. (Zentralinstitut fuer Kernforschung, Rossendorf bei Dresden (German Democratic Republic); Technische Univ., Dresden (German Democratic Republic). Sektion Physik). Apr 1986. NTIS (US Sales Only), PC A09/MF A01. Order Number DE88780092/JAW. (CONF-8511312—).

From 15. international symposium on nuclear physics - nuclear fission; Gaussig, German D.R. (11 Nov 1985).

The energy (E) and angle (Θ) dependent emission probability N(E,Θ) of fission neutrons is measured by the use of two parallel-plate avalanche counters (PPAC, one position-sensitive) for fragment detection (time of flight, direction) as well as two neutron detectors (D1, D2) for neutron detection (time of flight, detector response). The paper includes a description of the experimental setup, the multiparameter data acquisition and processing, and the analysis procedures. The arrangement permits the measurement of neutron angular distributions (in dependence of E) (i) for the whole angular range, (ii) with an angular resolution close to 3 deg, and (iii) with a rather high angle point density (up to 120 points in π). Due to the determination of the emission angle Θ by the measurement of fragment direction, i.e. fixed neutron detector position, systematic errors are avoided widely.

41991 (ZfK—592, pp 43-51) **Multiparameter measurements on charged particle associated fission of /sup 236/U.** Theobald, J.P. (Technische Hochschule Darmstadt (Germany, F.R.). Inst. fuer Kernphysik). Apr 1986. NTIS (US Sales Only), PC A09/MF A01. Order Number DE88780092/JAW. (CONF-8511312—).

From 15. international symposium on nuclear physics - nuclear fission; Gaussig, German D.R. (11 Nov 1985).

This is a report on two different multiparameter measurements on charged particle accompanied thermal neutron induced fission of /sup 236/U: (i) a measurement of relative charged particle yields and their kinetic energy distributions with the fission product separator 'LOHENGRIN' and (ii) a measurement of a complete set of kinematic parameters for fission fragments and associated alpha particles with the double torus ionization chamber 'DIOGENES'. Both instruments are operated at the high flux reactor of the ILL in Grenoble.

41992 (ZfK—592, pp 53-57) **Triton and alpha emission in the ternary fission of the actinides.** Wagemans, C.; Schillebeeckx, P.; D'Hondt, P.; Brisot, R. (Nuclear Physics Laboratory, Gent (Belgium); SCK/CEN, Mol (Belgium); SCK/CEN, Mol (Belgium); Institut Max von Laue - Paul Langevin, 38 - Grenoble (France)). Apr 1986. NTIS (US Sales Only), PC A09/MF A01. Order Number DE88780092/JAW. (CONF-8511312—).

From 15. international symposium on nuclear physics - nuclear fission; Gaussig, German D.R. (11 Nov 1985).

The energy characteristics and the emission probabilities of the tritons and the α-particles emitted in the thermal neutron induced ternary fission of /sup 233/U, /sup 235/U, /sup 239/Pu, /sup 241/Pu and /sup 241/Am have been studied using surface barrier ΔE-E telescope detectors. Within the experimental uncertainties, E/sub α/ and E/sub t/ appear to be constant, but the widths of these distributions and the α and t emission probabilities seem to be correlated with Z/sup 2//A and with the constant for radioactive α-decay λ of the fissioning system.

41993 (ZfK—592, pp 58-64) **Resonance parameters of Pu-239 in the resolved and unresolved resonance region.** Janeva, N. (Bylgarska Akademiya na Naukite, Sofia. Inst. za Yadrena Izsledvaniya i Yadrena Energetika). Apr 1986. NTIS (US Sales Only), PC A09/MF A01. Order Number DE88780092/JAW. (CONF-8511312—).

From 15. international symposium on nuclear physics - nuclear fission; Gaussig, German D.R. (11 Nov 1985).

The new approach to the multilevel analysis of Pu-239 neutron cross sections in the resolved and unresolved resonance region is presented. The resonance parameters and their average values in the unresolved resonance energy have been obtained.

41994 (ZfK—592, pp 65-69) **Measurement of the mean-square charge radii of neutron resonance states in uranium nuclei.** Meister, A.; Mittag, S.; Pikelner, L.B.; Pilz, W.; Seeliger, D.; Seidel, K. (Technische Univ., Dresden (German Democratic Republic); Joint Inst. for Nuclear Research, Dubna (USSR)). Apr 1986. NTIS (US Sales Only), PC A09/MF A01. Order Number DE88780092/JAW. (CONF-8511312—).

From 15. international symposium on nuclear physics - nuclear fission; Gaussig, German D.R. (11 Nov 1985).

The measurement of chemically induced shifts of neutron resonances provides information about the mean-square charge radii of nuclei at excitation energies around the neutron binding energies. Shifts were determined in neutron transmission spectra measured with time-of-flight technique at the Dubna pulsed reactor for several chemical uranium compounds, and analysed for ten low-energy resonances of /sup 234/U, /sup 235/U and /sup 238/U.

41995 (ZfK—592, pp 70-73) **Mean-square radii of the /sup 236/U nucleus in excited states with different fission widths.** Meister, A.; Mittag, S.; Pikelner, L.B.; Pilz, W.; Seeliger, D.; Seidel, K. (Technische Univ., Dresden (German Democratic Republic); Joint Inst. for Nuclear Research, Dubna (USSR)). Apr 1986. NTIS (US Sales Only), PC A09/MF A01. Order Number DE88780092/JAW. (CONF-8511312—).

From 15. international symposium on nuclear physics - nuclear fission; Gaussig, German D.R. (11 Nov 1985).

Experimentally determined mean-square charge radii of /sup 236/U compound-nucleus states excited by neutron resonance absorption in /sup 235/U, show on average a weak diminution as compared with the ground state data. A correlation of the <r/sup 2/> with the fission widths of the states seems to appear. An attempt is made to discuss this correlation in the frame of the double-humped barrier model successfully used to describe subthreshold fission. The <r/sup 2/> data are used to estimate the fraction of class II configurations in the excited compound-nucleus states with different fission widths.

41996 (ZfK—592, pp 78-81) **Fission cross section of /sup 243/Am in the threshold region (n,n'f).** Goverdovskij, A.A.; Kuz'minov, B.D.; Mitrofanov, V.F.; Sergachev, A.I. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk. Fiziko-Ehnergeticheskij Inst.). Apr 1986. (In Russian). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88780092/JAW. (CONF-8511312—).

From 15. international symposium on nuclear physics - nuclear fission; Gaussig, German D.R. (11 Nov 1985).

Fission cross sections of /sup 243/Am induced by neutrons with energies from 5 up to 11 MeV are measured and the results are discussed. Irregularities in the energy dependence are observed and could be explained in frame of a statistical model by emergence of competition of two main decay channels of the compound nucleus: fission and neutron emission.

41997 (ZfK—592, pp 82-87) **Experimental study of structures below the barrier in /sup 232/Th photofission cross sections.** Soldatov, A.S.; Aleksandrova, Z.A.; Smirenkin, G.N.; Tarasko, M.Z. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk. Fiziko-Ehnergeticheskij Inst.). Apr 1986. (In Russian). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88780092/JAW. (CONF-8511312—).

From 15. international symposium on nuclear physics - nuclear fission; Gaussig, German D.R. (11 Nov 1985).

/sup 232/Th photofission cross sections and yields are studied. The measurements are performed with bremsstrahlung in the energy ranges 5.0-5.3 MeV and 5.5-5.8 MeV, where wide resonances below the barrier are observed in earlier experiments. The results of the new experiment attest the fine structure of the resonances with characteristic intervals of 0.1 MeV between the resonances.

41998 (ZfK—592, pp 88-91) **Yield and photofission cross section of /sup 231/Pa.** Soldatov, A.S.; Rudnikov, V.E.; Aleksandrova, Z.A.; Smirenkin, G.N. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk. Fiziko-Ehnergeticheskij Inst.). Apr 1986. (In Russian). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88780092/JAW. (CONF-8511312—).

From 15. international symposium on nuclear physics - nuclear fission; Gaussig, German D.R. (11 Nov 1985).

For the first time fission yields for the reaction /sup 231/Pa(γ,f) are measured in the γ-quant energy range from 4.8 up to 7.0 MeV. The results are discussed and fission cross sections are determined.

41999 (ZfK—592, pp 92-95) **Photon induced fission of /sup 232/Th with 12 and 20 MeV bremsstrahlung.** Piessens, M.; Jacobs, E.; Frenne, D. de; Clercq, A. de; Verboven, M.; Smet, G. de. (Nuclear Physics Laboratory, Gent (Belgium)). Apr 1986. NTIS (US Sales Only), PC A09/MF A01. Order Number DE88780092/JAW. (CONF-8511312—).

From 15. international symposium on nuclear physics - nuclear fission; Gaussig, German D.R. (11 Nov 1985).

Gamma ray spectrometry of fission product catcherfoils and energy correlation measurements were performed for the photon induced fission of /sup 232/Th with 12 and 20 MeV bremsstrahlung. The postneutron mass distributions show a third peak for symmetric fission. In the light and heavy mass wings strong fine structures are observed, probably due to odd-even effects. As usually observed, the total preneutron fragment kinetic energy decreases with increasing excitation energy of the compound nucleus in the vicinity of mass 130. For symmetric fission however, the fragment kinetic energies show an increase. Compared to 12 MeV bremsstrahlung induced fission, the number of emitted neutrons increases for fission induced with 20 MeV bremsstrahlung. This can completely be attributed to the heavy fragment.

42000 (ZfK—592, pp 96-99) **Emission of /sup 3/H and /sup 4/He particles in the photofission of actinides.** Verboven, M.; Jacobs, E.; D'Hondt, P.; Clercq, A. de; Frenne, D. de; Piessens, M.; Smet, G. de. (Nuclear Physics Laboratory, Gent (Belgium)). Apr 1986. NTIS (US Sales Only), PC A09/MF A01. Order Number DE88780092/JAW. (CONF-8511312—).

From 15. international symposium on nuclear physics - nuclear fission; Gaussig, German D.R. (11 Nov 1985).

The emission of light charged particles (LCP) in the photofission of /sup 233/U, /sup 235/U, /sup 237/Np and /sup 242/Pu with 12, 15 and 20 MeV bremsstrahlung was studied. For the identification of the LCP ΔE-E detectortelescopes were used. We have determined the triton and α particle emission probabilities and the characteristics of the kinetic energy distribution of the α particles. Our measurements show that the excitation energy transferred to the compound nucleus essentially doesn't change the emission probability of the LCP. Our results are compared to sf and thermal neutron induced fission results. They are consistent with the idea that the LCP emission probability is correlated to the deformation energy of the system at scission.

42001 (ZfK—592, pp 122-126) **Fragment mass distributions in heavy-ion reactions leading to composite systems with Z = 108.** Gippner, P.; Schilling, K.D.; Seidel, W.; Stary, F.; Will, E.; Sodan, H.; Lukyanov, S.M.; Salamatin, V.S.; Penionzhkevich, Yu.E.; Chubarian, G.G. (Zentralinstitut fuer Kernforschung, Rossendorf bei Dresden (German Democratic Republic); Joint Inst. for Nuclear Research, Dubna (USSR); Erevanskij Fizicheskij Inst. (USSR)). Apr 1986. NTIS (US Sales Only), PC A09/MF A01. Order Number DE88780092/JAW. (CONF-8511312—).

From 15. international symposium on nuclear physics - nuclear fission; Gaussig, German D.R. (11 Nov 1985).

Fragment mass distributions are presented obtained by investigating the heavy-ion reactions /sup 22/Ne + /sup 249/Cf, /sup 32/S + /sup 238/U, /sup 40/Ar + /sup 232/Th and /sup 56/Fe + /sup 208/Pb leading to composite systems with the nuclear charge Z = 108. The experiments were performed at the heavy-ion cyclotron U300 of the Laboratory of Nuclear Reactions in Dubna. The spectrometer DEMAS was used to measure the times of flight and the laboratory angles of correlated fragments. The shape of the mass distributions strongly depends on the mass asymmetry in the entrance channel. By variation of the bombarding energy it is shown that near to the Coulomb barrier the mass distribution of the reaction /sup 32/S + /sup 238/U and /sup 40/Ar + /sup 232/Th exhibit relative maxima at M ~ 205, interpreted as due to stabilizing effects of nuclear shells during the fragmentation.

42002 (ZfK—592, pp 127-129) **Alpha-fragment correlation measurements in the reaction /sup 12/C (85 MeV) + /sup 232/Th.** Nguyen Hoai Chau; Augustyniak, W.; Borcea, C.; Lewitowicz, M. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Reactions). Apr 1986. NTIS (US Sales Only), PC A09/MF A01. Order Number DE88780092/JAW. (CONF-8511312—).

From 15. international symposium on nuclear physics - nuclear fission; Gaussig, German D.R. (11 Nov 1985).

The measurement of α-ff (fission fragment) correlations in heavy-ion reactions is an effective tool for obtaining information about the mechanism of the emission of high-energy nonequilibrium light particles. A measurement of the folding angle between fission fragments in coincidence with emitted light particles may also give information about the reaction time implied in the formation of these light particles. Some results of the study of α-ff correlation for the /sup 12/C(85 MeV) + /sup 232/Th reaction are presented. In contrast to the earlier mentioned works, the present one studies the reaction near the Coulomb barrier (E/sub cm/ - V/sub c/ = 15 MeV), and this offers the possibility of obtaining information about the weakly excited systems formed after light particle emission.

42003 (ZfK—592, pp 130-139) **Recent fission cross section standards measurements.** Wasson, O.A. (National Bureau of Standards, Gaithersburg, MD (USA)). Apr 1986. NTIS (US Sales Only), PC A09/MF A01. Order Number DE88780092/JAW. (CONF-8511312—).

From 15. international symposium on nuclear physics - nuclear fission; Gaussig, German D.R. (11 Nov 1985).

The /sup 235/U(n,f) reaction is the standard by which most neutron induced fission cross sections are determined. Most of these cross sections are derived from relatively easy ratio measurements to /sup 235/U. However, the more difficult /sup 235/U(n,f) cross section measurements require the use of advanced neutron detectors for the determination of the incident neutron fluence. Examples of recent standard cross section measurements are discussed, various neutron detectors are described, and the status of the /sup 235/U(n,f) cross section standard is assessed.

42004 (ZfK—592, pp 140-145) **Absolute measurements of the /sup 235/U induced fission cross section at the neutron energy of 1.88 MeV.** Alkhazov, I.D.; Dmitriev, V.D.; Kalinin, V.A.; Kavalenko, S.S.; Kutuzov, V.I.; Kuzmin, V.N.; Nemilov, Yu.A.; Petrov, B.F.; Solin, L.M.; Shpakov, V.I. (Radievyj Inst., Leningrad (USSR)). Apr 1986. NTIS (US Sales Only), PC A09/MF A01. Order Number DE88780092/JAW. (CONF-8511312—).

From 15. international symposium on nuclear physics - nuclear fission; Gaussig, German D.R. (11 Nov 1985).

The /sup 235/U neutron induced fission cross section is one of the most important neutron standard, responsible for an accuracy and reliability of numerous nuclear data. However especially in the neutron energy region from 1 MeV to 6 MeV the results obtained by different authors differ by a value exceeding 10%. Therefore some more absolute cross section measurement has been performed using the time-correlated associated-particle technique (TCAPT) at the new neutron energy spot point of 1.88 MeV that is near the maximum of the fission neutron energy spectrum. The results of the present work are discussed and compared with those obtained by other authors.

42005 (ZfK—592, pp 173-179) **Isomer ratio and cross section of the reaction /sup 237/Np(n,2n).** Ignatyak, A.V.; Kornilov, N.V.; Maslov, V.M.; Pashchenko, A.B. Apr 1986. (In Russian). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88780092/JAW. (CONF-8511312—).

From 15. international symposium on nuclear physics - nuclear fission; Gaussig, German D.R. (11 Nov 1985).

Isomer ratio and total cross section of the reaction /sup 237/Np(n,2n) are calculated by means of an optical statistical approach in frame of the Hauser-Feshbach theory in the energy range from threshold energy up to 20 MeV. The results are discussed and compared with experimental data.

42006 (ZfK—592, pp 152-155) **Absolute fission cross-section measurement of Pu-239 at 4.8, 8.65 and 18.8 MeV and of U-235 at 4.45 and 18.8 MeV neutron energy.** Herbach, C.M.; Merla, K.; Musiol, G.; Pausch, G.; Ortlepp, H.G.; Alkhazov, I.L.; Drapchinsky, L.V.; Ganza, E.A.; Kovalenko, S.S.; Kostochkin, O.I. (Technische Univ., Dresden (German Democratic Republic); Zentralinstitut fuer Kernforschung, Rossendorf bei Dresden (German Democratic Republic)). Apr 1986. NTIS (US Sales Only), PC A09/MF A01. Order Number DE88780092/JAW. (CONF-8511312—).

From 15. international symposium on nuclear physics - nuclear fission; Gaussig, German D.R. (11 Nov 1985).

The results of new fast neutron fission cross-section measurements carried out in the 1983-1985 years on Pu-239 and U-235 are presented. Using the 5 MV tandem accelerator of the CINR Rossendorf, the Time-Correlated Associated Particle Method (TCAPM) was applicated to open new energy spot points for absolute measurements. Corrections, errors and the main experimental features are summarized. Special problems of the 18.8 MeV measurements are discussed.

42007 **Search for an energy dependence in /sup 235/U delayed neutron spectra.** Sharfuddin, Q.; Schier, W.A.; Tanczyn, R.S.; Pullen, D.J.; Haghighi, M.H.; Fisteag, L.; Couchell, G.P. (Univ. of Lowell, Dept. of Physics and Applied Physics, Lowell, MA (US)). *Nuclear Science and Engineering;* **98**: No. 4, 341-347(Apr 1988).

A sensitive search for a dependence of composite (aggregate) delayed neutron spectra on the energy of neutrons inducing fission of /sup 235/U was performed for eight nearly contiguous delay time intervals between 0.17 to 85.5 s. The experimental arrangement combined a helium jet and tape transfer system with a beta-neutron time-of-flight spectrometer. Thermal and fast neutron measurements were performed successively. Results are compared with the spectra derived from individual precursor data complemented by theoretical estimates of missing spectra.

42008 **Prompt neutron emission multiplicity distribution and average values (Nubar) at 2200 m/s for the fissile nuclides.** Holden, N.E.; Zucker, M.S. (Brookhaven National Lab., National Nuclear Data Center, Upton, NY (US)). *Nuclear Science and Engineering;* **98**: No. 2, 174(Feb 1988).

The prompt neutron emission multiplicity distribution P/sub v/ and its average value <v> (i.e., nubar) have been determined at the standard neutron energy of 0.0253 eV for the neutron-induced fission of the four fissile nuclides /sup 233,235/U and /sup 239,241/Pu. Revised values of <v> have been obtained by re-evaluating <v> experiments measured at 2200 m/s relative to the <v> from the spontaneous fission of /sup 252/Cf. These revised values of <v> have been used to renormalize the measured P/sub v/ values. The revised values of <v> are all —0.25 to 0.5% smaller than the corresponding values of ENDF/B-V.

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REFER ALSO TO CITATION(S) 40812, 41074, 41812, 41860, 41924, 41928, 41936, 41939, 41963, 41995, 42008, 42358, 42360, 42361

42009 **(AD-A—191136/1/XAB) IDA gamma-ray laser annual summary report (1985). Investigation of the feasibility of developing a laser using nuclear transitions. Final report, August 1985-June 1986.** Balko, B.; Cohen, L.; Hartmann, F.X. (Institute for Defense Analyses, Alexandria, VA (USA)). Jun 1986. 177p. (IDA-P—2021). NTIS, PC A09/MF A01.

This report summarizes the IDA research effort in FY 1985 in investigating the feasibility of developing a gamma-ray laser.

42010 **(CBPF-NF—035/87) Systematics of photon - and electron - induced spallation reactions.** Foshina, M.; Martins, J.B.; Tavares, O.A.P.; Napoli, V. di. (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro; Rome Univ. (Italy). Ist. di Chimica Generale e Inorganica). (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro). 1987. 28p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703104/JAW.

A semi-empirical four-parameter formula is proposed in order to systematize intermediate- and high- energy photon- and electron-induced spallation cross sections and bremsstrahlung-induced spallation yields of medium weight nuclei. Analytical expressions for the parameters are obtained from parameter-values calculated by best-fitting of experimental data. We extend the same treatment to bremsstrahlung-induced spallation yields, and we verify that analytical expressions of the same form can be applied to estimate spallation yields. Such a four-parameter formula has shown to predict reliable values of unknown spallation reaction cross sections. The reproducibility of the experimental data by the present formula is comparable with or better than those by other semi-empirical formulae with a larger number of parameters.

42011 **(CEA-CONF—9319) Correlations and three-body effects in photo and electronuclear reactions.** Laget, J.M. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Service de Physique Nucleaire a Haute Energie). 1987. 14p. (CONF-8708143—). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88753930/JAW.

From 11. European conference on few-body physics; Fontevraud, France (31 Aug 1987).

The author tries to summarize the progresses which have been done, to review the relevant experiments to be performed at the few GeV electron machines and to discuss the problems raised by their analysis.

42012 **(CSIR-TWISK-TR—496) Numerical treatment of Faddeev integral equations for non-separable potentials.** Eyre, D. (Council for Scientific and Industrial Research, Pretoria (South Africa). National Research Inst. for Mathematical Sciences). Oct 1986. 12p. CSIR, National Research Institute for Mathematical Sciences, P O Box 395, Pretoria, 0001.

A finite element method is used to solve the three-body problem for bound states. Two-dimensional integral equations are approximated in a trial space of piecewise quadratic polynomials. Approximate solutions are obtained for a model problem of three spinless bosons interacting via the sum of S-wave Yukawa potentials. Numerical estimates for rates of convergence of the method are obtained.

42013 **(FRNC-TH—3278) /sup 3/H and /sup 3/He nucleus structure by Faddeev equations in the configuration space.** Laverne, A. (Grenoble-1 Univ., 38 (France)). Jun 1973. 92p. (In French). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88754207/JAW.

To solve the triton problem, Faddeev equations are solved in configuration space. The method is described (algorithm) together with some results with nucleon-nucleon potentials such as Reid potential and Tourreil and Sprung potential. A comparative study with helium 3 is given.

42014 **(GANIL-P—87-28) Dispersions in semi-classical dynamics.** Zielinska-Pfabe, M.; Gregoire, C. (Grand Accelerateur National d'Ions Lourds (GANIL), 14 - Caen (France)). 1987. 18p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88752434/JAW.

Dispersions around mean values of one-body observables are obtained by restoring classical many-body correlations in Vlasov and Landau-Vlasov dynamics. The method is applied to the calculation of fluctuations in mass, charge and linear momentum in heavy-ion collisions. Results are compared to those obtained by the Balian-Veneroni variational principle in semi-classical approximation.

42015 **(GSI—88-05) Hyperfission - a new mode of nuclear fission.** Ion, D.B.; Ivascu, M.; Ion-Mihai, R. (Institutul de Fizica si Inginerie Nucleara, Bucharest (Romania); Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (Germany, F.R.); Institutul de Fizica si Inginerie Nucleara, Bucharest (Romania); Bucharest Univ. (Romania). Faculty of Physics). (Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (Germany, F.R.); Institutul de Fizica si Inginerie Nucleara, Bucharest (Romania); Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (Germany, F.R.); Institutul de Fizica si Inginerie Nucleara, Bucharest (Romania)). Feb 1988. 9p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88754151/JAW.

In this paper the nuclear hyperfission as a new mode of fission, possible for heavy elements with Z > 92, is investigated. The Q-systematics, hyperfissibility parameters, hyperfission barrier as well as the essential hindrance factors are presented. The hyperfission hindrance factor relative to that of fission is found to be in the interval 1.0x10/sup -17/ - 3.4x10/sup -16/ for the parent nuclei with Z = 92-108.

42016 **(IAE—4427/2) Electronuclear sum rules and few-nucleon systems.** Ehfros, V.D. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1987. 23p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703138/JAW.

Formulations of sum rules (SR) for nucleus electrodisintegration are considered. The SR permit to study general properties of a nucleus, such as the type of longitudinal component of its interaction with field, some average values of NN-forces, the role of non-nucleon degrees of freedom. Similar model-independent SR for nuclei with A = 3 and 4 are presented. Complete calculations of SR for the nuclei are made and SR properties are analyzed. SR are compared with the experimental values for /sup 3/He. It is proved that longitudinal SR weighed with the energy mainly determines the universal function of nuclei. The function is calculated for /sup 4/He nucleus. SR containing essentially the same information that (e, e)-spectra, are suggested, but their calculation is much simpler than direct calculation of the spectra. 36 refs.; 4 tabs.

42017 **(IAE—4447/2) Polarization and alignment of nucleus fission fragments.** Barabanov, A.L.; Grechukhin, D.P. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1987. 17p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703140/JAW.

Correlation of fragment orientation with orientation axis of fissile nucleus and with n-vector/sub f/ vector of fragment divergence is considered. Estimations of polarization and alignment of fission fragments of preliminarily oriented nuclei in correlation (with n-vector/sub f/ recording) and integral (with n-vector/sub f/ averaging) experiments were conducted. It is shown that high sensitivity of polarization and fragment alignment to the character of nucleus movement at the stage of descent from barrier to rupture point exists. 15 refs.; 4 figs.; 1 tab.

42018 **(IC—88/49) α/sup 4/He elastic scattering at high energies.** Usmani, A.A.; Ahmad, I.; Usmani, Q.N. (Aligarh Muslim Univ. (India). Dept. of Physics; International Centre for Theoretical Physics, Trieste (Italy); Jamia Milia Islamia, New Delhi (India). Dept. of Physics). (International Centre for Theoretical Physics, Trieste (Italy)). Mar 1988. 14p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703168/JAW.

Differential cross sections for α/sup 4/He elastic scattering have been calculated at incident α particle momenta of 4.32, 5.07 and 7.0 GeV/c within the framework of the Glauber multiple scattering theory. The full Glauber amplitude is calculated using the Monte Carlo method for evaluating multidimensional integrals. We find that, in general, the more realistic double Gaussian model for the density brings theory closer to experiment as compared to the generally used single Gaussian model. Our results with the double Gaussian model are in fairly good agreement with the experimented data at 4.32 and 5.07 GeV/c. (author). 11 refs, 4 figs, 1 tab.

42019 **(IFUSP-P—661) Kinetic coefficients in inelastic high energy proton-nucleus scattering.** Rizzato, C.M.; Nemes, M.C.; Spina, M.E. (Sao Paulo Univ. (Brazil). Inst. de Fisica; Comision Nacional de Energia Atomica, San Carlos de Bariloche (Argentina). Centro Atomico Bariloche). (Sao Paulo Univ. (Brazil). Inst. de Fisica). Sep 1987. 15p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703175/JAW.

General expressions for the friction and diffusion coefficients for high energy proton-nucleus collisions are derived from an exact collisional description of the proton dynamics. Analytical expressions for both coefficients in nuclear matter are given. For low momentum transfers the Pauli blocking inhibites the friction and diffusion processes and this corresponds to the more realistic situations for proton incident energies ~1 GeV. Results are compared with the ones derived within the context of Glauber Theory/sup 1/] where Pauli blocking effects are not considered and the friction coefficient vanishes automatically.

42020 (INDC(NDS)—193/L, pp 47-53) **Count of p-h configurations by combinatorial method in the frame of BCS theory.** Reffo, G.; Herman, M.; do Rego, R.A. (ENEA, Bologna (Italy)). Jan 1988. NTIS (US Sales Only), PC A08/MF A01. Order Number DE88703050/JAW. (CONF-8610164—).

From International Atomic Energy Agency research coordination meeting on methods for the calculations of neutron nuclear data for structural materials; Bologna, Italy (6 Oct 1986).

A microscopic approach is described for the calculation of exciton level densities based on combinatorial method for the determination of the various configurations generated according to a given shell model spectrum of single particle levels. The total configuration energies are determined in the frame of BCS theory. The method allows for the spin and parity distribution and can be used indifferently both for spherical and deformed nuclei. We confine ourselves mainly to the results for aluminium to be used in preequilibrium calculations. (author). 9 refs, 10 figs.

42021 (INDC(NDS)—193/L, pp 113-127) **Consistent description of shell, superconductive and collective effects in the level density of structural materials.** Blokhin, A.I.; Ignatyuk, A.V. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk. Fiziko-Ehnergeticheskij Inst.). Jan 1988. NTIS (US Sales Only), PC A08/MF A01. Order Number DE88703050/JAW. (CONF-8610164—).

From International Atomic Energy Agency research coordination meeting on methods for the calculations of neutron nuclear data for structural materials; Bologna, Italy (6 Oct 1986).

The paper presents the results of a level density analysis based on the superfluid nuclear model. Using the random phase method, the temperature dependence of the coefficients of vibrational enhancement of level density was studied. On the basis of the results obtained, a phenomenological approach was developed to describe the level density of spherical nuclei in the mass number range A=50-65 in which the shell effects of the single-particle spectrum, the pair correlations of the superconducting type and the increase in level density due to collective vibrational modes are taken into account. (author). 30 refs, 11 figs.

42022 **(INDC(NDS)—193/L) Proceedings of the IAEA research coordination meeting on methods for the calculations of neutron nuclear data for structural materials, Bologna, Italy, 7-10 October 1986.** Goulo, V. (International Atomic Energy Agency, Vienna (Austria). Nuclear Data Section) (ed.). (International Atomic Energy Agency, Vienna (Austria). International Nuclear Data Committee; ENEA, Bologna (Italy). Centro di Calcolo). Jan 1988. 165p. (CONF-8610164—). NTIS (US Sales Only), PC A08/MF A01. Order Number DE88703050/JAW.

From International Atomic Energy Agency research coordination meeting on methods for the calculations of neutron nuclear data for structural materials; Bologna, Italy (6 Oct 1986).

The Meeting presentations were divided into 5 sessions devoted to the following aspects of nuclear theory for evaluation of fast neutron data: Development of Multistep Compound Reaction Models (3 papers), Exiton, Hybrid, Unified Pre-equilibrium Models

(4 papers), Description of Direct Processes (3 papers), Parametrization of Optical Model, Level Density Functions, Gamma-Ray Strength Functioning (3 papers) and Methods of Cross Section Evaluation (5 papers). A separate abstract was prepared for each of these papers. Refs, figs and tabs.

42023 (INDC(NDS)—193/L, pp 19-21) **Recent development of the multi-step compound reaction model.** Marcinkovski, A. (Institute for Nuclear Studies, Warsaw (Poland)). Jan 1988. NTIS (US Sales Only), PC A08/MF A01. Order Number DE88703050/JAW. (CONF-8610164—).

From International Atomic Energy Agency research coordination meeting on methods for the calculations of neutron nuclear data for structural materials; Bologna, Italy (6 Oct 1986).

Two-body interaction matrix elements in the frame of multi-step-compound reaction theory of Feshbach-Kermann-Koonin taking into amount the Pauli blocking and the Fermi energy constraint have been obtained for practical computations of nuclear data of structural materials. (author). 9 refs, 1 fig.

42024 (INDC(NDS)—193/L, pp 21-30) **Formation and emission of light particles in fast neutron induced reaction: A unified compound pre-equilibrium model (2).** Zhang Jingshang; Wen Yuanqi; Wang Shunuan; Shi Xiangjun. (Academia Sinica, Beijing, BJ (China). Inst. of Atomic Energy). Jan 1988. NTIS (US Sales Only), PC A08/MF A01. Order Number DE88703050/JAW. (CONF-8610164—).

From International Atomic Energy Agency research coordination meeting on methods for the calculations of neutron nuclear data for structural materials; Bologna, Italy (6 Oct 1986).

For fast neutron-induced reactions for structural materials by using the unified compound pre-equilibrium model, the light composite particles emissions have to be taken into account properly. The mechanism of cluster formation and emission have been investigated. Estimated results with considering secondary emission process have compared with experimental data. It shows that the unified compound pre-equilibrium model can be successfully used to evaluate nuclear data. (author). 6 refs, 5 figs, 2 tabs.

42025 (INDC(NDS)—193/L, pp 30-43) **Toward an improved multi-step direct multi-step compound reaction model.** Carlson, B.V.; Merchant, A.C. (Instituto de Estudos Avancados, Sao Jose dos Campos SP (Brazil). Div. de Fisica Teorica). Jan 1988. NTIS (US Sales Only), PC A08/MF A01. Order Number DE88703050/JAW. (CONF-8610164—).

From International Atomic Energy Agency research coordination meeting on methods for the calculations of neutron nuclear data for structural materials; Bologna, Italy (6 Oct 1986).

A multi-step direct multi-step compound model free of the criticisms suffered by that of Feshbach, Kerman and Koonin is defined in terms of the statistical hypotheses made about the interaction matrix elements. The model is briefly described and discussed. Also described are our unsuccessful attempts to parametrize the level and transition strength densities needed in pre-equilibrium calculations in terms of their moments. (author). 19 refs, 7 figs.

42026 (INDC(NDS)—193/L, pp 53-61) **Single particle effects in precompound decay reactions.** Blann, M.; Komoto, T.; Reffo, G.; Fabbri, F.; Grimes, S.M. (Lawrence Livermore National Lab., CA (USA); ENEA, Bologna (Italy); Ohio Univ., Athens (USA). Dept. of Physics). Jan 1988. NTIS (US Sales Only), PC A08/MF A01. Order Number DE88703050/JAW. (CONF-8610164—).

From International Atomic Energy Agency research coordination meeting on methods for the calculations of neutron nuclear data for structural materials; Bologna, Italy (6 Oct 1986).

Precompound decay models generally rely on the use of a partial state density formula assuming equidistantly spaced set of single particle levels. Large errors may be introduced by making the equidistant spacing assumption for nuclei with proton or neutron numbers near or at major shell closures. In this work the simple qualitative considerations of those deviations expected for near closed shell nuclei, compared with experimental results are reviewed, and then used partial state densities calculated with more realistic sets of single particle levels in precompound decay calculations for Zr targets. 13 refs, 14 figs.

42027 (INDC(NDS)—193/L, pp 61-72) **Effects of angular-momentum conservation in unified pre-equilibrium and equilibrium reaction models.** Shi Xiangjun; Gruppelaar, H.; Akkermans, J.M. (Netherlands Energy Research Foundation, Petten). Jan 1988. NTIS (US Sales Only), PC A08/MF A01. Order Number DE88703050/JAW. (CONF-8610164—).

From International Atomic Energy Agency research coordination meeting on methods for the calculations of neutron nuclear data for structural materials; Bologna, Italy (6 Oct 1986).

The master-equation theory of precompound and compound nuclear decay is generalized to the inclusion of the conservation of angular momentum. It is demonstrated that the constructed model contains the Hauser-Feshbach, Weisskopf-Ewing as well as standard exciton models as limiting cases. This unified pre-equilibrium/Hauser-Feshbach model, which may be considered as a practicable version of the quantum-statistical, so-called AWM theory of Agassi et al., has been computationally optimized, such that the related numerical effort has become comparable to or less than that of a standard Hauser-Feshbach calculation. With this unified model the nature and importance of some spin effects in pre-equilibrium reactions has been investigated. The main conclusion from numerical calculations is that the standard precompound-model results are close to those of the angular-momentum conserving model, implying that the popular semi-classical models are quite reliable in this respect from a practical point of view. (author). 29 refs, 6 figs.

42028 (INDC(NDS)—193/L, pp 73-77) **Neutron capture in the frame of the exciton model and total gamma-ray spectra calculations.** Reffo, G.; Costa, C.; Fabbri, F. (ENEA, Bologna (Italy)). Jan 1988. NTIS (US Sales Only), PC A08/MF A01. Order Number DE88703050/JAW. (CONF-8610164—).

From International Atomic Energy Agency research coordination meeting on methods for the calculations of neutron nuclear data for structural materials; Bologna, Italy (6 Oct 1986).

We realized the necessity of introducing the preequilibrium contribution to the neutron capture process in order to satisfy the need for gamma-ray spectra following neutron induced reactions in the structural material of the fusion technology. In this paper we describe and discuss the theoretical approach adopted. As an example, gamma-ray spectra calculations are shown for Nb, Co and Al. (author). 18 refs, 5 figs.

42029 (INDC(NDS)—193/L, pp 81-84) **Role of direct and pre-equilibrium processes in the description of threshold reaction excitation functions.** Grudzevich, O.T.; Ignatjuk, A.V.; Manokhin, V.N.; Pashchenko, A.B. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk. Fiziko-Ehnergeticheskij Inst.). Jan 1988. NTIS (US Sales Only), PC A08/MF A01. Order Number DE88703050/JAW. (CONF-8610164—).

From International Atomic Energy Agency research coordination meeting on methods for the calculations of neutron nuclear data for structural materials; Bologna, Italy (6 Oct 1986).

This paper gives consideration of the method of threshold reaction calculations which takes into account phenomenologically the integral contribution of direct processes in inelastic scattering of particles. (author). 9 refs, 2 figs.

42030 (INDC(NDS)—193/L, pp 84-93) **On methods for the calculation of neutron induced reactions.** Gmuca, S.; Antalik, R. (Slovenska Akademia Vied, Bratislava (Czechoslovakia). Fyzikalny Ustav). Jan 1988. NTIS (US Sales Only), PC A08/MF A01. Order Number DE88703050/JAW. (CONF-8610164—).

From International Atomic Energy Agency research coordination meeting on methods for the calculations of neutron nuclear data for structural materials; Bologna, Italy (6 Oct 1986).

A complete and consistent analysis of the more important interactions of neutrons with Cr isotopes in the energy range 2-20 Mev is presented. The integral-cross sections and the emission spectra are described using a combination of both the compound-nucleus and preequilibrium models. Emphasis is put on a simultaneous analysis of many reaction channels involved in the subreactions of neutrons with Cr isotopes using a consistent set of parameters.

42031 (INDC(NDS)—193/L, pp 93-104) **Gamma-ray spectra and angular distributions of photons following the capture of fast neutrons.** Longo, G.; Fabbri, F. (Istituto Nazionale di Fisica Nucleare, Bologna (Italy); ENEA, Bologna (Italy)). Jan 1988. NTIS (US Sales Only), PC A08/MF A01. Order Number DE88703050/JAW. (CONF-8610164—).

From International Atomic Energy Agency research coordination meeting on methods for the calculations of neutron nuclear data for structural materials; Bologna, Italy (6 Oct 1986).

It can be useful in fusion reactor research to obtain information on the production of high energy photons. For this purpose an outline of the direct-semidirect (DSD) model is given and the model is applied to calculate the cross sections for the production of 10-50 MeV photons following radiative capture of 4-50 MeV neutrons by /sup 40/Ca,/sup 48/Ti, /sup nat/Ni and /sup 120/Sn. It is shown that the model can allow useful predictions about the relative yield of high-energy gamma-rays emitted in different directions with respect to incident neutrons and that the angular distributions depend greatly on the parameters of giant multipole resonances and on the level structure of final nuclei. (author). 18 refs, 14 figs.

42032 (INDC(NDS)—193/L, pp 107-112) **Calculation of γ-ray cascades in code ALICE.** Blann, M.; Reffo, G.; Fabbri, F. (California Univ., Livermore (USA). Lawrence Livermore National Lab.; ENEA, Bologna (Italy)). Jan 1988. NTIS (US Sales Only), PC A08/MF A01. Order Number DE88703050/JAW. (CONF-8610164—).

From International Atomic Energy Agency research coordination meeting on methods for the calculations of neutron nuclear data for structural materials; Bologna, Italy (6 Oct 1986).

We describe the methods used to calculate γ-ray cascades in the code ALICE/LIVERMORE 300. Results are compared with experimental spectra for /sup 93/Nb (n,xγ), /sup 27/Al (n,xγ) and /sup 197/Au (n,xγ) at ϵ/sub n/=9.5, 14 and 18.5 MeV (average bin energies), and for /sup 181/Ta (n,xγ) at 14 MeV. The /sup 93/Nb and /sup 181/Ta γ-ray spectra are also compared with results of the ENEA code PENELOPE. (author). 6 refs, 12 figs.

42033 (INDC(NDS)—193/L, pp 127-133) **G.H.D. pre-equilibrium emission model and statistical model parameters for structural material fast neutron data calculations.** Ivascu, M.; Avrigeanu, M.; Avrigeanu, V. (Institutul de Fizica si Inginerie Nucleara, Bucharest (Romania)). Jan 1988. NTIS (US Sales Only), PC A08/MF A01. Order Number DE88703050/JAW. (CONF-8610164—).

From International Atomic Energy Agency research coordination meeting on methods for the calculations of neutron nuclear data for structural materials; Bologna, Italy (6 Oct 1986).

Inclusion of the angular momentum conservation in the Geometry Dependent Hybrid (GDH) pre-equilibrium emission subroutine of the Hauser-Feshbach code STAPRE is discussed. The consistency of the statistical model nuclear level density and the equivalent particle-hole state density has been achieved following a unitary use of an energy dependent level density parameter. The neutron and charge particles optical model potentials selected from literature are commented. The E1 gamma-ray strength functions, used in the gamma-ray transmission coefficient evaluation, have been taken from an empirically modified energy-dependent Breit-Wigner (EDBW) model. The proper account of the nuclear level density over a large energy range has been obtained through the use of the empirical back-shifted Fermi gas (BSFG) model, at medium excitation energies, and of a realistic analytical formula with microscopic suggested parameters at the high excitation energies. The necessary transition excitation range between the two different density approaches, in the mass range $40<A<65$, has been discussed. (author). 30 refs, 3 figs.

42034 (INDC(NDS)—193/L, pp 137-147) **Neutron scattering on nuclei near A=60 and A=90.** Lawson, R.D.; Smith, A.B. (Argonne National Lab., IL (USA). Applied Physics Div.). Jan 1988. NTIS (US Sales Only), PC A08/MF A01. Order Number DE88703050/JAW. (CONF-8610164—).

From International Atomic Energy Agency research coordination meeting on methods for the calculations of neutron nuclear data for structural materials; Bologna, Italy (6 Oct 1986).

Over a wide range of incident energies, the total cross section and angular distributions for elastic scattering of neutrons from nuclei in these mass regions are analyzed using the spherical-optical-statistical model. The effect of a real-surface-peaked potential, predicted by dispersion relations, is considered. It is found that when the data on a given nucleus between say, 4.5 and 10 MeV, are analyzed simultaneously one obtains a smooth energy variation of the optical model parameters. Moreover, this parameterization may be used to predict, quite accurately, at least the total cross sections up to 20 MeV. The parameters characterizing the model are quite different in the two mass regions. However, a comparison of the optical model results for /sup 89/Y and /sup 93/Nb indicates that near A=90 the well parameters are nearly the same for the two nuclei and that the volume integrals of the imaginary potentials are similar. (author). 16 refs, 9 figs, 2 tabs.

42035 (INDC(NDS)—193/L, pp 148) **Neutron induced reaction cross-sections of iron in the energy range 1 to 20 MeV: A work programme.** Garg, S.B.; Anand, R.P. (Bhabha Atomic Research Centre, Bombay (India)). Jan 1988. NTIS (US Sales Only), PC A08/MF A01. Order Number DE88703050/JAW. (CONF-8610164—).

From International Atomic Energy Agency research coordination meeting on methods for the calculations of neutron nuclear data for structural materials; Bologna, Italy (6 Oct 1986).

Iron is one of the main constituents of stainless steel which is used as a structural material in nuclear reactors. In fast and conceptual fusion and fusion-fission hybrid systems the primary energy range of neutron interaction lies between 1 and 20 MeV which opens up several reaction channels. The reaction cross-sections in this energy range are important for dosimetry, radiation damage, neutronics and safety studies of nuclear reactors. Keeping this in view Nuclear Data Section of the International Atomic Energy Agency has sponsored a Research Co-ordination Programme on Methods for the Calculation of Fast Neutron Nuclear Data for Structural Elements. Under this programme we propose to study (n,n'), (n,2n), (n,3n), (n,p), (n,np), (n,pn), (n,α), (n,nα), (n,αn) and (n,γ) reaction cross-sections. Besides these, total, elastic and discrete level inelastic scattering cross-sections, angular distributions of neutron production cross-sections, neutron emission spectrum and charged particle emission spectra for protons and alpha particles will also be estimated. We propose to investigate the above mentioned neutron interaction cross-sections with multistep Hauser-Feshbach, Kalbach exciton, Blann's Geometry Dependent Hybrid, Weisskopf-Ewing evaporation and Brink-Axel giant dipole models. A literature survey of the measured cross-section data of iron, optical model parameters used by other investigators for neutron, proton and alpha particles and energy level parameters has been made. Computer codes utilizing some of the above listed nuclear models have been commissioned and tested. A brief report will be presented on the planned evaluation work programme and some of the preliminary results obtained.

42036 (INDC(NDS)—193/L, pp 148-155) **Transformation formulas for Legendre coefficients of double-differential cross sections.** Shi Xiangjun; Gruppelaar, H.; Akkermans, J.M.; Zhang Jingshang. (Netherlands Energy Research Foundation, Petten; Academia Sinica, Beijing, BJ (China). Inst. of Atomic Energy). Jan 1988. NTIS (US Sales Only), PC A08/MF A01. Order Number DE88703050/JAW. (CONF-8610164—).

From International Atomic Energy Agency research coordination meeting on methods for the calculations of neutron nuclear data for structural materials; Bologna, Italy (6 Oct 1986).

Approximate analytical formulas have been derived for the transformation of Legendre coefficients of double-differential continuum cross sections of two-body nuclear reactions from the center-of-mass to the laboratory system. A difference with respect to the transformation of elastic-scattering angular distribution coefficients is that the accuracy depends not only upon the target mass, but also on outgoing energies. A fast code has been written to transform Legendre coefficients of neutron inelastic scattering cross-sections. This code has been used to check the results for some simple problems with analytical solutions. For more complicated problems in which the energy spectrum is either an evaporation spectrum or a spectrum obtained from a (pre-)-compound

model calculation comparisons have been made with a recently introduced numerical integration method. The results are quite satisfactory provided that the target mass or the outgoing energy is not too low. (author). 6 refs, 1 fig., 1 tab.

42037 (INDC(NDS)—193/L, pp 156-160) **Neutron production from 14-MeV neutron on 27A1.** Reffo, G.; do Rego, R.A.; Fabbri, F. (ENEA, Bologna (Italy)). Jan 1988. NTIS (US Sales Only), PC A08/MF A01. Order Number DE88703050/JAW. (CONF-8610164—).

From International Atomic Energy Agency research coordination meeting on methods for the calculations of neutron nuclear data for structural materials; Bologna, Italy (6 Oct 1986).

Calculations of 14.5 MeV neutron cross sections on 27A1 were performed in the frame of Hauser-Feshbach theory, generalized optical model and the exciton model for preequilibrium emission contributions. In order to achieve a better agreement between theory and experimental data the necessity of a microscopic level density was shown. (author). 16 refs, 8 figs.

42038 (INDC(NDS)—193/L, pp 161-165) **Optical-statistical calculations of the chromium neutron cross-sections.** Konshin, V.A.; Korennoj, V.P.; Ulanovsky, A.V.; Fokov, Yu.G.; Khatkevich, O.V. (Institute of Nuclear Power Engineering, Minsk (USSR)). Jan 1988. NTIS (US Sales Only), PC A08/MF A01. Order Number DE88703050/JAW. (CONF-8610164—).

From International Atomic Energy Agency research coordination meeting on methods for the calculations of neutron nuclear data for structural materials; Bologna, Italy (6 Oct 1986).

The quality of σ/sub t/ and σ/sub nn'/ neutron cross-section description of /sup 52/Cr in the E<5 MeV region has been analyzed. The impact of uncertainties in the calculated transmission coefficients at low energies on nearthreshold cross-sections of compound-processes accompanied by a neutron emission has been discussed. It has been shown that the introduced energy dependence of a potential diffusivity makes it possible to describe a specific minimum in the chromium total cross-section at E~0.8 MeV and to improve the description of σ/sub nn'/. At neutron energies of several MeV, it becomes necessary to calculate transmission coefficients of emitted charged particles. To perform such calculations, the procedure is proposed to eliminate the uncertainty in the choice of optical potential parameter sets. It has been shown that the depth of a real part of the optical potential can be approximated by the linear function of a reduced particle-nucleus mass. (author). 19 refs, 4 figs, 1 tab.

42039 (INIS-SU—5/A, pp 29-35) **Evolution of cold dense nuclear matter.** Hefter, E.F.; Kartavenko, V.G. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1987. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88780078/JAW. (JINR-N—3(23)-87).

In JINR rapid communications. Collection.

A simple analytical model is presented to describe the time evolution of cold compressed nuclear systems. The inverse mean-field method has been used. A one-dimensional three-level system is analysed in detail. Inverse methods are shown to give us the opportunity to predict the (nonlinear) evolution of cold dense nuclear systems. 21 refs.

42040 (INIS-SU—5/A, pp 36-40) **Evaluation of the energy-weighted moments in the random phase approximation.** Kuz'min, V.A. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1987. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88780078/JAW. (JINR-N—3(23)-87).

In JINR rapid communications. Collection.

Based on spectral decomposition of the real symmetrical matrix method for evaluating the energy-weighted moments of the transition strength distribution over the excitation energies defined in the random phase approximation (RPA) is presented. It is shown that certain linear combinations of these moments can be expressed through the product of the RPA matrices. The obtained results are used to select two-quasiparticle states that are most important for given transitions and residual interactions. 6 refs.

42041 (ITF—87-21) **Effective long-range potential in three-particle theory.** Zepalova, M.L. (AN Ukrainskoj SSR, Kiev. Inst. Teoreticheskoj Fiziki). 1987. 9p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88703320/JAW.

The problem of Coulomb scattering of a particle by a two-particle system is considered in the case of an arbitrary form of nuclear forces. Integral equations are formulated to determine the scattering amplitude and the effective potential of the interaction between an incident particle and a two-particle subsystem. The behaviour of the polarization potential is investigated for small transferred momenta. 11 refs.

42042 (ITF—87-45) **Perturbation theory in interaction range for the three-particle problem.** Simenog, I.V.; Shapoval, D.V. (AN Ukrainskoj SSR, Kiev. Inst. Teoreticheskoj Fiziki). 1987. 19p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703321/JAW.

A correct definition of the zero interaction range limit for a system of three spinless particles and three particles in the doublet state is given. The scattering amplitude is expanded in terms of the range r, and corrections ~ rlnr, r and r/sup 2/ln/sup 2/r are calculated. The explicit model-independent asymptotic expression of the scattering amplitude in terms of the scattering length is obtained and its accuracy is found. 16 refs.

42043 (ITP—86-159) **Just one more hydrodynamic scenario of ultrarelativistic nuclear collisions.** Gorenshtejn, M.I.; Pavlenko, O.P.; Zinov'ev, G.M. (AN Ukrainskoj SSR, Kiev. Inst. Teoreticheskoj Fiziki). 1986. 9p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702818/JAW.

A new hydrodynamic scenario of ultrarelativistic nuclear collisions is discussed. It includes two stages: one-dimensional scaling expansion and break-up of a hydrodynamic system into separate spheric droplets. The correlation between the average transverse momentum and multiplicity (sensitive to the quark-hadron phase transition) is calculated. 14 refs.; 2 figs.

42044 (ITP—87-32) **On threshold anomaly in doublet nd-scattering.** Shapoval, D.V.; Simenog, I.V.; Sitnichenko, A.I. (AN Ukrainskoj SSR, Kiev. Inst. Teoreticheskoj Fiziki). 1987. 7p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88703328/JAW.

Calculations of the doublet nd-scattering phase shift which probe to be the evidence of its anomal behaviour near the three-particle threshold are carried out. The case when the doublet nd-scattering length a/sub 2/ is close to experimental value is shown to be the most favourable one to manifest the threshold effect. 13 refs.; 2 figs.

42045 (ITP—87-64) **Hydrodynamics of hadron matter under pion interferometric microscope.** Makhlin, A.N.; Sinyukov, Yu.M. (AN Ukrainskoj SSR, Kiev. Inst. Teoreticheskoj Fiziki). 1987. 13p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703329/JAW.

A method which makes it possible to find out the hydrodynamical motion of hadron matter produced in ultrarelativistic pp and p-barp collisions is proposed. The method is based on the analysis of Bose-Einstein pion correlations. It makes it possible to measure the time, the expansion rate and the freezing temperature for the matter produced in the central region of high-energy hadronic and nuclear collisions. 13 refs.; 3 figs.

42046 (ITP—87-66) **Evaporation of hadrons with large P/sub T/ and dilepton emission from the mixed phase of QCD matter in ultrarelativistic nuclear collisions.** Gorenshtejn, M.I.; Pavlenko, O.P. (AN Ukrainskoj SSR, Kiev. Inst. Teoreticheskoj Fiziki). 1987. 17p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703330/JAW.

To probe the mixed phase of QCD matter we study thermal dilepton emission and hadron evaporation with large P/sub perpendicular/ in the framework of hydrodynamical model for ultrarelativistic nuclear collisions. 19 refs.; 4 figs.

42047 (JINR—R-4-87-70) Determination of nucleon effective number in reactions like photoproduction of charged pions on nuclei by absorption and inelastic cross sections. Kurochkin, V.P.; Kuptsov, A.V. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1987. 10p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88701664/JAW.

Incoherent inclusive processes like photoproduction of charged pions on nuclei A(γ, π/sup +-/), A(π/sup +-/, γ), and A(π/sup +-/, e/sup +/e/sup -/) are considered. The minimum and maximum values of the effective number of nucleons in these reactions (corresponding to "good" and "bad" energy resolution) are shown to be determined in the region of Δ(1236)-resonance by the total inelastic cross section for interaction of pions with the given nucleus and by the absorption part of this cross section, respectively. Values of the effective number of nucleons, calculated in this way for /sup 7/Li and /sup 12/C nuclei at the kinetic pion energy 125-380 MeV, are compared with the available experimental values. One of the calculated values is used to find the cross section for the reaction π/sup +/n -> e/sup +/e/sup -/p and the isovector nucleon form factor F/sub 1//sup v/ via the cross section for the reaction /sup 7/Li(π/sup +/, e/sup +/e/sup -/)X at the 380 MeV kinetic pion energy. 14 refs.; 1 fig.; 2 tabs.

42048 (JINR—R-4-87-395) Electromagnetic characteristics of low-lying states in the two-rotor nuclear model. Mikhajlov, I.N.; Yuldashbaeva, Eh.Kh.; Briancon, Ch. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1987. 16p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702827/JAW.

Submitted to the journal Sov. J. Nucl. Phys. .

The nonadiabatic effects are explored caused by excitation of M1-mode among the states of g-, β- and γ-bands within the two-rotor model which assumes the rotation of neutron component as a whole with respect to the proton component. The positive parity state spectrum of /sup 232/Th nucleus is investigated. Common expressions for multipole operators and fundamental matrix elements for M1 and E2 transitions are obtained. Reduced probabilities of M1 and E2 transitions out of β- and γ-bands into ground band states and their ratio are calculated. The comparison with experimental data is presented, and the ratio of M1 and E2 decay probabilities of γ-band states for /sup 232/Th nucleus is estimated. 8 refs.; 8 tabs.

42049 (JINR—R-6-87-203) Description of the ZORKA program for the computer calculation of the physical constants of the ground state and quadrupole vibrational states and transitions in even-even deformed nuclei. Adam, I.; Vagner, V.; Gonusek, M.; Krivopustov, M.I.; Morozov, V.A. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1987. 8p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88701668/JAW.

The program is described for calculation (from experimental values of reduced probabilities B(E2), B(M1) or their ratios) of the "physical constants" of the ground and quadrupole vibrational states and of gamma-transitions in even-even deformed nuclei. There was assumed the mixing of the wave function of ground, β- and γ-vibrational states. Calculations in the program ZORKA are based on the least-square method. 8 refs.; 2 figs.; 2 tabs.

42050 (JINR-E—1-87-695) Determination of the hadron mean free path for particle-producing collisions in intranuclear matter by measurement. Strugalski, Z.; Mousa, M. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy; Politechnika Warszawska (Poland). Inst. Fizyki). (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1987. 9p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88703342/JAW.

It is shown how it is possible to determine the hadron mean free path <λ/sub in/> for particle-producing collisions in intranuclear matter by measurement. The mean free path for the collisions of pions inside /sub 54//sup 131/Xe nuclei at 3.5 GeV/c momentum has been measured. The relation between <λ/sub in/> in units nucleons/S and the hadron-nucleon inelastic cross section σ/sub in/ in units S/nucleon is found: <λ/sub in/>kl/σ/sub in/, where S~10 fm/sup 2/, k=3.0+-0.15; physical meaning of S is given in this paper. 18 refs.; 2 figs.

42051 (JINR-E—4-87-162) DWIA in the momentum space for (γ,π/sup 0/) reaction near threshold. Chumbalov, A.A.; Eramzhyan, R.A.; Kamalov, S.S. (Kazakhskij Gosudarstvennyj Univ., Alma-Ata (USSR); AN SSSR, Moscow. Inst. Yadernykh Issledovanij; Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1987. 20p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703360/JAW.

Submitted to the journal Z. Phys. A - Atoms and Nuclei.

Differential cross sections and total cross sections of coherent photoproduction of neutral pions on /sup 4/He,/sup 12/C and /sup 40/Ca nuclei using impulse approximation and the method of distorted waves in impulse representation are calculated. Pion distortion wave effects near threshold of photon energy are shown not to exceed 25%. Good agreement with the experiment is reached due to the application of total elementary amplitude, which takes into account both nonlinear terms in a pion momentum and the terms, which depends on the pion momentum. 26 refs.; 5 figs.; 4 tabs.

42052 (JINR-E—4-87-747) Microscopic boson approach to the description of sd-shell nuclei. Kuchta, R. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1987. 14p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703362/JAW.

A microscopic method is proposed for analyzing the properties of light nuclei with an equal number of protons and neutrons in terms of many interacting bosons. An exact boson image of the underlying shell-model Hamiltonian is derived and the dynamical behaviour of the original fermion system is studied directly in the boson picture using the mean field approximation. The resulting boson states are shown to be free from spurios components, so that the cubersome procedure of constructing the physical boson states can be avoided. The method is applied to calculating the energy spectra of /sup 20/Ne, /sup 24/Mg and a satisfactory agreement with experimental data is found. 27 refs.; 1 fig.; 1 tab.

42053 (JINR-E—4-87-753) Mean field boson treatment of the electron scattering form factors in /sup 18/O. Kuchta, R. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1987. 12p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703363/JAW.

An extended mean field boson approach to proton-neutron systems with n/sub π/ not = n/sub ν/ is proposed an applied to calculating the energy spectra as well as the electron scattering form factors for the 0/sup +/ -> 0/sup +/ and 0/sup +/ -> 2/sup +/ transitions in /sup 18/O. Provided the single-particle orbitals are taken from the lowest three major oscillator shells and all nucleons are allowed to be active, the agreement with experimental data is very good. The results are also compared with those obtained in the restricted sd-shell subspace, which enables one to estimate the effects of possible excitations of the /sup 16/O core. It is found that such effects are non-negligible. 18 refs.; 5 figs.

42054 (JINR-R—3-87-742) Determination of the neutron and radiative strength functions by using (n,α) reaction. Andrzejewski, J.; Vo Kim Thanh. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics). 1987. 5p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88703403/JAW.

The method for determining the neutron strength functions by using averaged cross sections of the (n, a) reaction is described. The preliminary values of the neutron and radiative strength functions for /sup 143/Nd and /sup 147/Sm nuclei have been obtained. 8 refs.; 2 figs.; 1 tab.

42055 **(LA-UR—88-1664) Mesic interactions and trinuclear physics.** Picklesimer, A. (Los Alamos National Lab., NM (USA)). 1988. Contract W-7405-ENG-36. 16p. (CONF-8806130—1). NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88010946/JAW.

From Relativistic nuclear many-body physics conference; Columbus, OH, USA (6 Jun 1988).

The author discusses the nuclear three body problem, especially as regards prediction of the triton binding energy by the use of static Bonn potentials. He concludes that two body and three body forces need to be treated in a unified and ocnsistent manner to successfully solve the triton binding energy problem.

42056 **(LYCEN—8712) Semi-classical calculation of the spin-isospin response functions.** Chanfray, G. (Lyon-1 Univ., 69 - Villeurbanne (France). Inst. de Physique Nucleaire). Mar 1987. 3p. (CONF-8703153—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88753974/JAW.

From International workshop on semi-classical and phase-space approaches to the dynamics of the nucleus; Aussois, France (16 Mar 1987).

We present a semi-classical calculation of the nuclear response functions beyond the Thomas-Fermi approximation. We apply our formalism to the spin-isospin responses and show that the surface peaked $h/2\pi$ corrections considerably decrease the ratio longitudinal/transverse as obtained through hadronic probes.

42057 **(UCRL—98167) Recollections on the development of preequilibrium decay models.** Blann, M. (Lawrence Livermore National Lab., CA (USA)). Feb 1988. Contract W-7405-ENG-48. 5p. (CONF-880232—5). NTIS, PC A02/MF A01; GPO Dep. Order Number TI88008036/JAW.

From Nuclear Energy Agency Nuclear Data Committee (NEANDC) specialists' meeting on preequilibrium nuclear reactions; Semmerling, Austria (10 Feb 1988).

This paper contains a review of some of the accomplishments of the pre-equilibrium decay models. 23 refs. (LSP)

42058 (ZfK—592, pp 1-17) **On the mechanism of fission neutron emission.** Maerten, H.; Richter, D.; Seeliger, D.; Neubert, W. (Technische Univ., Dresden (German Democratic Republic). Sektion Physik; Zentralinstitut fuer Kernforschung, Rossendorf bei Dresden (German Democratic Republic)). Apr 1986. NTIS (US Sales Only), PC A09/MF A01. Order Number DE88780092/JAW. (CONF-8511312—).

From 15. international symposium on nuclear physics - nuclear fission; Gaussig, German D.R. (11 Nov 1985).

This review represents the present knowledge of the mechanism of prompt fission neutron emission. Starting with a brief fission process characterization related with neutron emission, possible emission mechanisms are discussed. It is emphasized that the experimental study of special mechanisms, i.e. scission neutron emission processes, requires a sufficiently correct description of emission probabilities on the base of the main mechanism, i.e. the evaporation from fully accelerated fragments. Adequate statistical-model approaches have to account for the complexity of nuclear fission reflected by an intricate fragment distribution. The present picture of scission neutron emission is not clarified neither experimentally nor theoretically. Deduced data are contradictory and depend on the used analysis procedures often involving rough discriptions of evaporated-neutron distributions. The contribution of two secondary mechanisms of fission neutron emission, i.e. the neutron evaporation during fragment acceleration and neutron emission due to the decay of /sup 5/He after ternary fission, is estimated. We summarize the recent progress of the theoretical description of fission neutron spectra in the framework of statistical models considering the standard spectrum of /sup 252/Cf(sf) neutrons especially. The main experimental basis for the study of fission neutron emission is the accurate measurement of emission probabilities as a function of emission energy and angle (at least) as well as fragment parameters (mass number ratio and kinetic energy). The present status is evaluated.

42059 (ZfK—592, pp 100-107) **Odd harmonics in the angular distribution of fission fragments.** Flambaum, V.V. (AN SSSR, Novosibirsk. Inst. Yadernoj Fiziki). Apr 1986. NTIS (US Sales Only), PC A09/MF A01. Order Number DE88780092/JAW. (CONF-8511312—).

From 15. international symposium on nuclear physics - nuclear fission; Gaussig, German D.R. (11 Nov 1985).

Asymmetry in the angular distribution of light and heavy fragments may become a source of information about a direct nuclear fission (induced by photons, neutrons and charged particles) and about the statistical properties of compound states. Investigation of the asymmetry can prove to be useful for further study of the properties of the fission channels and in a search for new parity violation effects.

42060 (ZfK—592, pp 117-120) **Catapult mechanism for fast particle emission after scission.** Maedler, P. (Joint Inst. for Nuclear Research, Dubna (USSR)). Apr 1986. NTIS (US Sales Only), PC A09/MF A01. Order Number DE88780092/JAW. (CONF-8511312—).

From 15. international symposium on nucleaf physics - nuclear fission; Gaussig, German D.R. (11 Nov 1985).

It is shown in TDHF approximation that the final disintegration of the prefragments is accompanied by a rapid snatching of the inner tails of the mean field including velocities of 0.1c or even larger. A nucleon moving towards the snatching ends with Fermi velocity becomes reflected, acquires additionally twice that velocity, and can escape with an energy of several tens MeV (preferentially along the scission axis). The proposed mechanism loses its purpose when neglecting self-consistency.

42061 (ZfK—592, pp 121) **Polar particle emission in spontaneous fission.** Milek, B.; Reif, R.; Revai, J. (Technische Univ., Dresden (German Democratic Republic). Sektion Physik; Hungarian Academy of Sciences, Budapest. Central Research Inst. for Physics). Apr 1986. NTIS (US Sales Only), PC A09/MF A01. Order Number DE88780092/JAW. (CONF-8511312—).

From 15. international symposium on nuclear physics - nuclear fission; Gaussig, German D.R. (11 Nov 1985).

42062 **Modeling fission-gas behavior in metallic fuels.** Gruber, E.E.; Kramer, J.M. (Argonne National Lab., Argonne, IL (US)). *Journal of the American Ceramic Society;* 70: No. 10, 699-703(Oct 1987). Contract W-31-109-ENG-38.

The FRAS3 code, developed to model transient fission-gas behavior in oxide fuel, has been modified for application to metallic fuel. The code has been applied to analyze a series of experiments on irradiated uranium fuel, in which fission-gas bubble distributions were measured following isothermal anneals under various pressures. Comparison of the calculated bubble-size distributions to those measured indicates that grain-boundary bubbles are an important components of the observed size distributions. The calculated results agree will with the observed results in both the general nature of the distributions and their variation with pressure. Results are not as consistent for an anneal under vacuum, during which a large amount of gas was released.

42063 **A new two-body wave equation with relativistic kinematics.** Lichtenberg, D.B. (Institute for Nuclear Theory, Univ. of Washington, Seattle, WA (US)). *Modern Physics Letters A;* 2: No. 10, 795-800(Oct 1987).

The authors propose a new phenomenological two-body wave equation with relativistic kinematics which has certain advantages for treating quarkonium, including quarkonium decay processes.

42064 **Relativistic equation for nucleon-nucleus scattering.** Wallace, S.J. (Dept. of Physics and Astronomy, Univ. of Maryland, College Park, MD 20742 (US)). pp 267-292 of Annual review of nuclear and particle science, Volume 37. Jackson, J.D. Palo Alto, CA; Annual Reviews Inc. (1987).

In this review, primary emphasis is placed on the relativistic approach to proton scattering based on NN amplitudes. Much of the current interest in relativistic nuclear physics stems from this

approach and its successful predictions of spin observables in elastic proton scattering. Moreover, these aspects of the relativistic approach make contact with a large body of experimental work on nucleon-nucleus scattering and they can be tested in various ways. There is a close connection between the relativistic optical potential and the mean field potential responsible for nuclear binding. To emphasize this connection, a unified discussion of relativistic approaches to the nuclear mean field and to the nucleon optical potential is presented.

42065 **Pion-nucleus interactions.** Gibbs, W.R.; Gibson, B.F. (Theoretical Div., Los Alamos National Lab., Los Alamos, NM 87545 (US)). pp 411-462 of Annual review of nuclear and particle science, Volume 37. Jackson, J.D. Palo Alto, CA; Annual Reviews Inc. (1987).

The pion is an hadronic probe with many facets. The multiple research aspects contain complex interconnections. In an attempt to present some of the developments in pion-nucleus physics, the authors separated the field into areas closely associated with specific goals. The inherent danger in such an approach is clear: the reader's attention may be too narrowly focused and important collateral observations missed. This danger is largely offset by the advantage of giving the reader a thread to follow. Thus, the authors present a series of minireviews, each one largely independent of the others, along with the basic physics background needed by a non-expert. Each topic is worthy of a separate review, but they seek to gather here an overview of the field.

42066 **Nuclear effects in deep inelastic lepton scattering.** Berger, E.L.; Coester, F. (Argonne National Lab., Argonne, IL 60439 (US)). pp 463-492 of Annual review of nuclear and particle science, Volume 37. Jackson, J.D. Palo Alto, CA; Annual Reviews Inc. (1987).

In this paper, the authors review the data and interpretations of the EMC effect, concluding with a summary of desirable future investigations. They begin with a summary of the relevant kinematic relations and the definition of the invariant structure functions. Data are summarized in Section 3 along with general statements regarding their interpretation. In Section 4, the authors review the spectrum of models proposed to explain the data, concentrating specifically on the rescaling approach and on explanations in terms of nuclear binding. One of their conclusions, expressed in Section 5, is that current data are fully compatible with an interpretation in terms of conventional nuclear binding. There is no hard evidence in these data for new QCD effects such as a change in the confinement size of nucleons. However, more precise data, especially at small values of the Bjorken scaling variable chi (chi$<\delta$0.30 are desirable for future quantitative tests of all interpretations.

42067 **Calculations of muon capture in D/sub 2//T/sub 2//He mixtures.** Cohen, J.S. (Theoretical Div., Los Alamos National Lab., Los Alamos, NM (US)). pp 8 of Contributions to the muon catalyzed fusion workshop. Idaho Falls, ID; Idaho National Engineering Lab. (1985). (CONF-840660—).

From Workshop on muon-catalyzed fusion reactions; Jackson, WY, USA (7 Jun 1984).

The first step in the muon-catalyzed fusion cycle is slowing down and capture of the negative muon in isotopic hydrogen mixtures. The authors used two methods for calculating this process: the classical-trajectory Monte Carlo (CTMC) approach and the diabatic-state model. Previous CTMC calculations probably give the most accurate published cross sections for μ/sup -/capture by hydrogen isotopes. However, those results are somewhat uncertain since, while the momentum distribution in the H-atom is given exactly, the position distribution is not described well by the microcanonical ensemble employed. A description has now been developed that simultaneously treats the position and the momentum distributions with sufficient accuracy. As the moment of helium in the mixture builds up (/sup 3/He from tritium decay or /sup 4/He from fusion), the catalytic action is poisoned. Cross sections for μ/sup -/ capture by He have also been calculated. Determination of the fraction captured by He requires, in addition, proper description of the muon-energy transport. Results for hydrogen/helium mixtures are presented and the tolerable contamination by He deduced. All existing calculations for capture of μ/sup -/ by hydrogen have actually been done for H atoms. The molecular case is considerably more complicated; e.g., in μ/sup -/ + H/sub 2/ collisions, adiabatic ionization is impossible, but rovibrational excitation or dissociation can occur. A theory to treat the dynamics of μ/sup -/ + H/sub 2/ has been developed. Preliminary results are discussed.

42068 **α-sticking probability.** Morgan, D.L. Jr. (Lawrence Livermore National Lab. (US)). pp 12 of Contributions to the muon catalyzed fusion workshop. Idaho Falls, ID; Idaho National Engineering Lab. (1985). (CONF-840660—).

From Workshop on muon-catalyzed fusion reactions; Jackson, WY, USA (7 Jun 1984).

The possibility that the muon may become bound to the α in D+T+μ-→n+α+μ- limits the number of times the μ- can catalyze D-T fusion. Hence the importance of calculating the α-sticking probability. The sticking probability depends on the form of the μ-wave function in each of the bound states of the DTμ- molecule when the D-T separation is zero. Calculations of this wave function in the Born-Oppenheimer approximation or by minimization of the energy of the DTμ- molecule may not be sufficiently accurate for determining the sticking probability for all bound states. Two alternatives for determining the wave function were considered. In the first, the time-dependent Schroedinger equation is solved for the μ-wave function while the D-T motion is treated classically. In the second, an integral form of the Schroedinger equation is solved directly by a numerical-iterative technique for the complete DTμ-wave function.

6540 Radiation And Shielding Physics

REFER ALSO TO CITATION(S) 39738, 39753, 40455, 41034, 41078, 41113, 42326

42069 **(CEA-R—5423) Integral form of the radiation transfer equation.** Munier, A. (CEA Centre d'Etudes de Limeil, 94 - Villeneuve-Saint-Georges (France)). Feb 1988. 115p. (In French). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88754051/JAW.

The integral form of the radiation transfer equation is given in a non-scattering medium for which the source and absorption terms are known explicitly. The problem is solved for an one-dimensional, inhomogeneous, non stationary, non isotropic configuration, in cartesian and spherical coordinates for arbitrary initial and boundary conditions. The same problem is solved for a boundary condition that is given on a moving surface, then the three-dimensional problem is examined in cartesian coordinates.

42070 **(CONF-880601—10) Some preliminary design considerations for the ANS [Advanced Neutron Source] reactor cold source.** Henderson, D.L. (Oak Ridge National Lab., TN (USA)). 1988. Contract AC05-84OR21400. 9p. NTIS, PC A02/MF A01;1; GPO Dep. Order Number DE88005187/JAW.

From American Nuclear Society annual meeting; San Diego, CA, USA (12 Jun 1988).

Two areas concerned with the design of the Advanced Neutron Source (ANS) cold source have been investigated by simple one-dimensional calculations. The gain factors computed for a possible liquid nitrogen-15 cold source moderator are considerably below those computed for the much colder liquid deuterium moderator, as is reasonable considering the difference in moderator temperature. Nevertheless, nitrogen-15 does represent a viable option should safety related issues prohibit the use of deuterium as a moderating material. The slab geometry calculations have indicated that reflection of neutrons may be the dominant moderating mechanism and should be a consideration in the design of the cold source. 9 refs., 2 figs.

42071 **(CONF-880601—12) Flattening the power distribution of the Advanced Neutron Source Reactor.** Difilippo, F.C. (Oak Ridge National Lab., TN (USA)). 1988. Contract AC05-84OR21400. 8p. NTIS, PC A02/MF A01;1; GPO Dep. Order Number DE88005185/JAW.

From American Nuclear Society annual meeting; San Diego, CA, USA (12 Jun 1988).

The goal of the Advanced Neutron Source Project is to design an ultrahigh thermal neutron flux ({approximately}10^{16}/cm^{2}sec) scattering facility with a reactor as a source of neutrons. Efficient design requires the combination of a low absorbing reflector and a small---relative to the neutron slowing-down length---core. The results of this combination are a larger than usual average power density (compared to other high flux reactors) and a highly skewed distribution of the power density if the fuel is uniformly loaded. Both of these characteristics, and thermohydraulic limits, make necessary the use of some remedial technique to flatten the power distribution. Use of burnable poissons to flatten the power distribution is an alternative that might not be feasible in our case because of the characteristics of the Advanced Neutron Source (ANS): small core, extremely hard neutron spectra and reactivity constraints. We have developed instead an iterative numerical technique to calculate a fuel distribution that will reduce the power peaking factor at a prescribed time during the life of the core. 5 refs., 2 figs.

42072 **(EUR—11095) Neutronic spectrometry measurements in sodium.** Perlini, G.; Acerbis, S. (Commission of the European Communities, Ispra (Italy). Joint Research Centre). 1987. 34p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88753952/JAW.

Measurements were made of neutronic penetration in sodium, which could serve as a reference and as a benchmark for computer codes. The model employed consisted of an assembly of 7 containers full of sodium for a total of 10 tons and a useful length of almost 4 metres. Measurements were performed at various depths along the central axis of the structure with proton recoil proportional counters. The energy band explored was between 100 and 650 keV. Here we report not only the original spectra of the impulses but also the neutronic spectra found by unfolding with the SPEC-4 code.

42073 **(JAERI-M—88-036) User's guide of a plotting program PLTJOINT.** Sasaki, Makoto; Sato, Wakaei; Nakagawa, Masayuki; Mori, Takamasa. (Japan Atomic Energy Research Inst., Tokyo). Feb 1988. 59p. NTIS (US Sales Only), PC A04/MF A01. Order Number DE88754119/JAW.

A plotting program PLTJOINT is able to plot various types of input and output data from neutronics calculations with two dimensional coordinates. These data include cross sections, neutron flux or spectrum, reaction rate distribution and auxiliary data. These are read from the input and output files of the JOINT system and the transport code system using double differential form cross section, and from arbitrary BCD input file. General purpose option is also available. Much care is taken in lettering such as types of characters (italic, Greek letters and characters), super and subscript of alphabet and numeral. Users can design their own characters by using a program IGDRASIL. Most of input data can be read in free format. The code has been programed so flexibly that new functions can be easily added to.

42074 **(JINR-E—1-87-76) Statistical modeling in phenomenological description of electromagnetic cascade processes produced by high-energy gamma quanta.** Slowinski, B. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Computing Techniques and Automation). 1987. 8p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88703341/JAW.

Submitted to the Second International Tampere Conference in Statistics, Jun 1 - 4 1987.

A description of a simple phenomenological model of electromagnetic cascade process (ECP) initiated by high-energy gamma quanta in heavy absorbents is given. Within this model spatial structure and fluctuations of ionization losses of shower electrons and positrons are described. Concrete formulae have been obtained as a result of statistical analysis of experimental data from the xenon bubble chamber of ITEP (Moscow). 3 refs.; 2 figs.; 1 tab.

42075 **(LA—11301-C) A neutron reflectometer for LANSCE?.** Hyer, D.K. (comp.). (Los Alamos National Lab., NM (USA)). Jun 1988. Contract W-7405-ENG-36. 39p. (CONF-8711190—Summs.; CONF-8711190—). NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88010591/JAW.

From Workshop on a neutron reflectometer for LANSCE; Los Alamos, NM, USA (2 Nov 1987).

This paper discusses topics on the neutron reflectometer for LANSCE. Contained in the appendices are the following contributing papers: Polymer Adsorption Profiles, Polymer Concentration Profile Observed by Neutron Reflection, Neutron Reflection from Solid Films, Aspects of the Instrumentation for a LANSCE Neutron Reflectometer, Neutron Reflection from Magnetic and Superconducting Materials, Neutron Reflection from the Surface of Liquids, Prospects for Neutron Reflectometry Studies of Polymer Systems, Comparison of Reactor and Pulsed-Source-Based Reflectometers, Diffuse Scattering and the Effects of Roughness, and Guidelines for Design of a LANSCE Reflectometer.

42076 **Discrete angle biasing in Monte Carlo radiation transport.** Cramer, S.N. (Oak Ridge National Lab., P.O. Box X, Building 6025, Oak Ridge, TN (US)). *Nuclear Science and Engineering;* **98**: No. 4, 279-298(Apr 1988).

An angular biasing procedure is presented for use in Monte Carlo radiation transport with discretized scattering angle data. As in more general studies, the method is shown to reduce statistical weight fluctuations when it is combined with the exponential transformation. This discrete data application has a simple analytic form that is problem independent. The results from a sample problem illustrate the variance reduction and efficiency characteristics of the combined biasing procedures, and a large neutron and gamma-ray integral experiment is also calculated. A proposal is given for the possible code generation of the biasing parameter rho and the preferential direction Ω/sub 0/ used in the combined biasing schemes.

42077 **Effectiveness of a consistently formulated diffusion-synthetic acceleration differencing approach.** Khalil, H. (Argonne National Lab., Applied Physics Div., 9700 South Cass Avenue, Argonne, IL (US)). *Nuclear Science and Engineering;* **98**: No. 3, 226-243(Mar 1988).

A consistently formulated differencing approach is applied to the diffusion-synthetic acceleration of discrete ordinates calculations based on various spatial differencing schemes. The diffusion "coupling" equations derived for each scheme are contrasted to conventional coupling relations and are shown to permit derivation of either point- or box-centered diffusion difference equations. The resulting difference equations are shown to be mathematically equivalent, in slab geometry, to equations derived by applying Larsen's four-step procedure to the S/sub 2/ equations. Fourier stability analysis of the acceleration method applied to slab model problems is used to demonstrate that, for any S/sub n/ differencing scheme (a) the upper bound on the spectral radius of the method occurs in the fine-mesh limit and equals that of the spatially continuous case (0.22466), and (b) the spectral radius decreases with increasing mesh size to an asymptotic value <0.13135. This model problem performance is somewhat superior to that of Larsen's approach, for which the spectral radius is bounded by 0.25 in the wide-mesh limit. Numerical results of multidimensional, heterogeneous, scattering-dominated problems are also presented to demonstrate the rapid convergence of accelerated discrete ordinates calculations using various spatial differencing schemes.

42078 **Gamma-ray transport in a shield-tissue composite system and the buildup factor implications.** Gopinath, D.V.; Subbaiah, K.V.; Trubey, D.K. (Safety Research Lab., Indira Gandhi Centre for Atomic Research, Kalpakkam 603 102 (IN)). *Nuclear Science and Engineering;* **97**: No. 4, 362(Dec 1987).

Transport computations in shield-tissue composite systems are presented. It is observed that the scattered gamma-ray spectra at the interface, which are governed by the reflectivities of different media, are significantly different from those of an infinite medium. The interface effects also extend back into the shield medium, the extent depending on the atomic number of the medium

and energy of the source photons. The implications of these differences on the dose distribution and buildup factors in the shield-tissue system are significant. These studies show that in many cases the infinite-medium buildup factors are quite inadequate to compute the maximum dose in the tissue following a shield. Appropriate correction factors are given. The singular behavior of the spectrum due to source photons of energy close to but above the K edge of the medium is highlighted.

6550 Medical Physics

REFER ALSO TO CITATION(S) 39779, 39962, 40856, 41053, 41071, 41071, 41094, 41095, 41117, 41270, 41271, 41561, 41563, 42003, 42004, 42078

42079 **(GSF—17/87) 1986 statistical results of the Official Personal Dosimetry Service at GSF.** Drexler, G.; Eckerl, H.; Haid, G.; Scheibe, D. (Gesellschaft fuer Strahlen- und Umweltforschung m.b.H. Muenchen, Neuherberg (Germany, F.R.). Auswertungsstelle fuer Strahlendosimeter). Sep 1987. 51p. (In German). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88752647/JAW.

The report consists of a summary of relevant statistical data from the official personal dosimetry in 1985. Under survey were occupationally exposed persons in the states of Bavaria, Hessen and Schleswig-Holstein. The data are based on the survey of more than 6500 institutions with nearly 83000 persons and are derived from approx. 1000000 single measurements. The report covers informations on the institutions, on the persons as well as dosimetric values. The measuring method is described briefly with respect to dosimeters used, their range and the interpretation of values. Information on notional doses and the interpolation of values nearby the detection limits are given.

42080 **(INIS-mf—11250) Metrology of ionizing radiation quantities in nuclear power.** Jasanovsky, P. (Ceskoslovenska Vedeckotechnicka Spolecnost, Prague. Dum Techniky). 1986. 9p. (In Czech). (CONF-8606407—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88703064/JAW.

From 12. national seminar on measurements in power engineering; Zdar nad Sazavou, Czechoslovakia (9 Jun 1986).

Published in seminar proceedings "Metrologie jadernych elektraren", p. 114-122.

Cooperation at state, departmental and enterprise levels is provided in Czechoslovakia in metrological activity in nuclear power, namely in the metrology of ionizing radiation. The Centre of State Metrology and its scientific and research base provides legal measurement and other specialized services to nuclear power. The highest executive level of departmental metrology is the network of metrological centres which are designed for every nuclear power plant locality. At enterprise level executive metrology is provided by units of administrators of measuring instruments. A detailed description is presented of the structure of means for the metrology of ionizing radiation quantities. Attention is also focused on different types of metrological activities and their implementation, the parameters of measuring instruments and measuring sources. The types of measuring instruments and measuring sources for different types of ionizing radiation quantities are listed. (Z.M.).

42081 **(INIS-mf—11251) Radiation protection requirements on metrology at nuclear power plants.** Bucina, I. (Ceskoslovenska Vedeckotechnicka Spolecnost, Prague. Dum Techniky). 1986. 6p. (In Czech). (CONF-8606407—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88703065/JAW.

From 12. national seminar on measurements in power engineering; Zdar nad Sazavou, Czechoslovakia (9 Jun 1986).

Published in seminar proceedings "Metrologie jadernych elektraren", p. 123-128.

Demands placed by radiation protection on metrology in a nuclear power plant proceed from monitoring programs for personnel protection and the protection of the population in the environment of the plant. Monitoring comprises actual measurement and assessment of measurement results in relation to dose limits and the effects of radiation on people. The importance of calibration is outlined for dosimetric methods with regard to physical, psychological and legal aspects. Also analysed are reasons which led to the choice of new variables for monitoring external irradiation and for monitoring the environment as defined in ICRU 39 (International Commission on Radiation Units and Measurements) Report of 1985. (Z.M.).

42082 **(INIS-mf—11253) Ionizing radiation metrology at the Dukovany nuclear power plant.** Zelenka, Z.; Kopec, J. (Ceskoslovenska Vedeckotechnicka Spolecnost, Prague. Dum Techniky). 1986. 3p. (In Czech). (CONF-8606407—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88703067/JAW.

From 12. national seminar on measurements in power engineering; Zdar nad Sazavou, Czechoslovakia (9 Jun 1986).

Published in seminar proceedings "Metrologie jadernych elektraren", p. 147-149.

The system of radiation inspection at the Dukovany nuclear power plant in four reactor units consists of more than 1,200 radioactivity and ionizing radition meters. Metrological activity for assuring the reliable operation of the system may be divided into the calibration of the measuring instruments and detection systems and the calibration of the whole measurement route. The equipment is described of the calibration unit for radiation inspection instruments. The calibration unit provides the testing of basic sensitivity of instruments for measuring exposure rate, gamma flux density, neutron flux density and surface contamination. As for the other measuring instruments it can only measure standard sensitivity. The calibration units has not as yet been provided with equipment for the calibration of the basic sensitivity of instruments for measuring specific activity of liquids and gases. (Z.M.).

42083 **(INIS-mf—11747) Optimization of dose distribution in radiation therapy with a movable source according to the after-loading procedure.** Quirin, A. (Kiel Univ. (Germany, F.R.). Medizinische Fakultaet). 10 Dec 1986. 54p. (In German). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88754020/JAW.

A calculation program for a computer for the dose-atlas-independent, individual therapy planning for the afterloading apparatus Gamma-MedII is presented. A basis program determines with the inclusion of X-ray pictures after the administration of a reference dose the dose distribution and the irradiation times for a determined target volume. For the optimization of the three-dimensional dose distribution the Simplex algorithm is used. The results show with a non-bent application probe no deviations between assumed and calculated reference doses.

42084 **(INIS-mf—11767) Effects of inhomogeneities on the dose distribution in the linear accelerator when using electron beams.** Eilers, A. (Marburg Univ. (Germany, F.R.). Fachbereich Humanmedizin). 26 Mar 1986. 132p. (In German). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88754168/JAW.

Tissue equivalents for lungs and bones according to DIN 6800 (air and magnesium filled tubes) were put into a water phantom and irradiated with a Mevatron 74. The dose distribution behind an inhomogeneity depends on it directly: the depth in the tissue behind it and the lateral expansion where effects have to be taken into consideration in planning the irradiation increase with the degree of the inhomogeneity (i.e. the tube diameter). In a longer distance behind an air-filled cavity (increase of the depth of the measuring point), the absolute dose decreases, but compared with undisturbed conditions it increases. In the case of inhomogeneous depositions with a density stranger than that of the surrounding substance, the peak is found to behave correspondingly, but with a negative sign. With increasing depth (increase in the tubes central position), the inhomogeneity loses its effect on the dose.

42085 **(JINR—18-87-670) LET spectrum spatial distribution in water absorber exposed to high energy nucleons.** Serov, A.Ya.; Sychev, B.S.; Cherevatenko, E.P. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1987. 11p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703339/JAW.

The calculations of the LET dose spectra in water absorber exposed to neutron beams having energies from 100 to 600 MeV protons have been carried out with the aim to interprete results of radiobiological and dosimetric investigations on therapeutical neutron high energy beam of JINR Nuclear problems Laboratory. The calculations have been carried out using modernized computer program MEDICA calculating in arbitrary point of absorber spatial and energy distribution of primary and secondary particles fluence generated as a result of internuclear cascade development in absorber material. The LET values of charged particles and recoils, depending upon their energy, have been calculated using the computer program DEDXR. The total and partial LET dose spectra for different thicknesses of water absorber within the beam zone and out of one are demonstrated. The calculations show that under growth neutron energy the widening of spectra takes place either in the direction of low or high LET values. The LET value average for 12 cm depth of water absorber has the largest one under 350 MeV neutron energy. 15 refs.; 8 figs.; 1 tab.

42086 **(LBL—24941) Field characterization and personal dosimetry at a high energy ion accelerator.** Greenhouse, N.A.; Busick, D.D.; de Castro, T.M.; Elwyn, A.J.; Hankins, D.E.; Ipe, N.E; La Plant, P.R.; McCaslin, J.B.; Renner, T.R.; Smith, A.R.; Sun, R.K.S.; Swanson, W.P. (Lawrence Berkeley Lab., CA (USA); Stanford Linear Accelerator Center, Menlo Park, CA (USA); Fermi National Accelerator Lab., Batavia, IL (USA); Lawrence Livermore National Lab., CA (USA)). Mar 1988. Contract AC03-76SF00098. 11p. (CONF-880404—6). NTIS, PC A03/MF A01. Order Number DE88008208/JAW.

From 7. international congress of the International Radiation Protection Association; Sydney, Australia (10 Apr 1988).

The response of a variety of dosimeters was evaluated in the radiation field outside the shielding of the Lawrence Berkeley Laboratory Bevalac Biomedical Facility. The primary beam was 580 MeV{center+dot}A neon ions, incident upon a 30.5-cm polyethylene cube. The field was characterized by a neutron spectrometer consisting of Bonner spheres and other detectors and by estimates of charged particle fluences in NTA film and in the Berklet spectrometer. The responses of American Acrylics CR-39 track-etch plastic detectors and AECL (Canada) type BD-100 Bubble Detectors were compared to those of NTA film, Andersson-Braun rem-meter and recombination-chamber results as well as to reference dose equivalents based upon the unfolded neutron spectrum. Evaluations of these dosimeters are discussed. 7 refs., 4 figs.

42087 **(SAAS—356) Radiation exposure to radon daughters. Quantities, units, dose factors, limits.** Przyborowski, S. (Staatliches Amt fuer Atomsicherheit und Strahlenschutz, Berlin (German Democratic Republic)). 1986. 42p. (In German). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703081/JAW.

A description is given of the special quantities and units that are necessary for assessing internal radiation exposures resulting from radon daughters. Following a discussion of the dose factors recommended by international bodies for radiation workers as well as for indoor and outdoor exposure of individual members of the public, recommendations are derived on how to apply these factors in radiation protection practice in the GDR. Finally dealt with are both the internationally recommended limits for exposure to radon daughters and the ones valid in the GDR for the time being.

42088 **MLE reconstruction of a brain phantom using a Monte Carlo transition matrix and a statistical stopping rule.** Veklerov, E.; Llacer, J.; Hoffman, E.J. (Lawrence Berkeley Lab., Univ. of California, Berkeley, CA (US)). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* 35: No. 1, 603-607(Feb 1988). (CONF-871006—).

From 34. nuclear science symposium and 19. nuclear power systems symposium; San Francisco, CA, USA (21 Oct 1987).

In order to study properties of the Maximum Likelihood Estimator (MLE) algorithm for image reconstruction in Positron Emission Tomography (PET), the algorithm is applied to data obtained by the ECAT-III tomograph from a brain phantom. The procedure for subtracting accidental coincidences from the data stream generated by this physical phantom is such that the resultant data are not Poisson distributed. This makes the present investigation different from other investigations based on computer-simulated phantoms. It is shown that the MLE algorithm is robust enough to yield comparatively good images, especially when the phantom is in the periphery of the field of view, even though the underlying assumption of the algorithm is violated. Two transition matrices are utilized. The first uses geometric considerations only. The second is derived by a Monte Carlo simulation which takes into account Compton scattering in the detectors, positron range, etc. in the detectors. It is demonstrated that the images obtained from the Monte Carlo matrix are superior in some specific ways. A stopping rule derived earlier and allowing the user to stop the iterative process before the images begin to deteriorate is tested. Since the rule is based on the Poisson assumption, it does not work well with the presently available data, although it is successful with computer-simulated Poisson data.

42089 **Computer-controlled testing and calibration of health physics instruments.** Swinth, K.L.; Sisk, D.R. (Pacific Northwest Lab., P.O. Box 999, Richland, WA (US)). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* 35: No. 1, 567-570(Feb 1988). (CONF-871006—).

From 34. nuclear science symposium and 19. nuclear power systems symposium; San Francisco, CA, USA (21 Oct 1987).

A microcomputer-controlled CAMAC system has been adapted for automated testing and calibration of health physics survey instruments. Once the survey instrument is mounted, the system automatically performs tests for angular dependence or geometry dependence. Positioning the instruments is performed by a computer-controlled stepping motor, read-out is performed by an auto-ranging digital voltmeter, and data is stored on computer disks.

6560 Condensed Matter Physics

REFER ALSO TO CITATION(S) 40245, 40357, 40358, 40360, 40390, 40405, 40408, 40439, 40453, 40456, 40457, 40457, 40515, 40642, 41750, 41751, 41861, 41904

42090 **(AD-A—191687/3/XAB) General qualitative study of point and extended defects and their interactions in nonmetallic systems. Annual technical report, 1 January-31 December 1987.** Kunz, A.B.; Suits, B.H.; Woodward, C.; Marshall, S.A. (Michigan Technological Univ., Houghton (USA)). 31 Dec 1987. 67p. NTIS, PC A04/MF A01.

This report describes progress in developing and implementing a general theoretical approach to describing the properties of defects and impurities of a general nature in nonmetallic solid systems. Also, progress in complementary nondestructive experimental tests is reviewed. These tests employ and extend newly developed techniques in EPR and NMR imaging in solids. First-of-a-kind EPR imaging experiments were performed, and a new NMR imaging laboratory was constructed.

42091 **(CBPF-NF—038/87) Absolute datation methodes of the plio-quaternary by "radiation dammage": fission tracks, thermoluminescence, electronique paramagnetic resonance.** Poupeau, G. (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro). 1987. 9p. (In French). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88703105/JAW.

We describe the methods of absolute age estimation of minerals from the quaternary, by the analysis of fission tracks, thermoluminescence and electronic paramagnetic resonance. (M.W.O.).

42092 **(CBPF-NF—046/87) Nuclear hyperfine interactions and chemical bonding in high T/sup C/ superconductors.** Danon, J. (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro). 1987. 17p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703106/JAW.

Nuclear quadrupole resonances of Cu/sup 63/ and Fe/sup 57/ Moessbauer spectroscopy of the high temperature superconductor YBa/sub 2/Cu/sub 3/O/sub 7-γ/ e described together with synchrotron radiation studies of the copper oxidation states in this material. The Moessbauer spectra of /sup 57/Fe in the two distinct

crystallographic sites of the Cu atoms in YBa/sub 2/Cu/sub 3/O/sub 7-γ/ are very similar from the quadrupole coupling point of view although exhibiting markedly different values for the isomer shift. The role of oxygen vacancies in the hyperfine interactions is discussed.

42093 **(CEA-INSTN—9-1(1987)) Positron annihilation spectroscopy of native vacancies in as-grown GaAs.** Corbel, C.; Stucky, M.; Moser, P.; Hautojarvi, P. (Institut National des Sciences et Techniques Nucleaires (INSTN), Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France)). 1987. 66p. NTIS (US Sales Only), PC A04/MF A01. Order Number DE88752393/JAW.

Native vacancy defects are studied in as-grown GaAs materials by positron lifetime measurements. Direct evidence of native monovacancy-type defects is found in as-grown n-type GaAs (Te, Sn or Si) but not in as-grown semi-insulating In or Cr doped GaAs or semi-insulating undoped GaAs or p-type GaAs(Zn). It is shown that the positron trapping and annihilation in the native defects is strongly dependent on the position of the Fermi level in as-grown n-GaAs. It is concluded that the configurations of the native monovacancy defects in GaAs (Te or Sn) change with the position of the Fermi level. Two Fermi level controlled transitions are found: one is located between 0.02 eV and 0.05 eV, the other is about 0.12 eV below the conduction band. It is proposed that the two transitions correspond to two charge state transitions of the arsenic vacancy.

42094 **(CONF-8806161—1) Experimental studies of the chemistry of metal clusters.** Parks, E.K.; Riley, S.J. (Argonne National Lab., IL (USA)). 1988. Contract W-31109-ENG-38. 37p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88012034/JAW.

From Enrico Fermi School of Physics on nonlinear topics in ocean physics conference; Varenna, Italy (28 Jun 1988).

The procedures for studying chemical reactions of metal clusters in a continuous-flow reactor are described, and examples of such studies are given. Experiments to be discussed include kinetics and thermodynamics measurements, and determination of the composition of clusters saturated with various adsorbate reagents. Specific systems to be covered include the reaction of iron clusters with ammonia and with hydrogen, the reaction of nickel clusters with hydrogen and with ammonia, and the reaction of platinum clusters with ethylene. The last two reactions are characterized by complex, multi-step processes that lead to adsorbate decomposition and hydrogen desorption from the clusters. Methods for probing these processes will be discussed. 26 refs., 8 figs.

42095 **(DOE/ER/13089—T4) Continuous Damage Theory: Progress report, August 1985-August 1986.** Krajcinovic, D. (Illinois Univ., Chicago (USA)). 1986. Contract AC02-83ER13089. 3p. NTIS, PC A02/MF A01;1; GPO Dep. Order Number DE88012249/JAW.

This research program is concerned with formulating models of damage mechanics in solids. The primary objectives of the project during the reporting period were: (a) to establish a common ground between existing phenomenological models and compare them to a model developed during the first two years of this project, and (b) to formulate a micromechanically based continuum damage model. A list of publications, papers, and presentations is provided. (DWL)

42096 **(DOE/ER/45211—5) The pair potential approach for interfaces: Fundamental problems and practical solutions.** Maggs, A.C.; Ashcroft, N.W. (Cornell Univ., Ithaca, NY (USA). Lab. of Atomic and Solid State Physics). Sep 1987. Contract FG02-85ER45211. 7p. (MSC—6356; CONF-870793—6). NTIS, PC A02/MF A01;1; GPO Dep. Order Number DE88009165/JAW.

From Conference on interface science and engineering; Lake Placid, NY, USA (12 Jul 1987).

A fundamental problem in the use of a central pair-force model for defect problems is that it omits three-body and higher terms which are necessarily present in real systems. Electronic fluctuation effects are also usually omitted. While these can be small in the simple metals, they are significant in noble and transition metals, as shown by a simple real space argument. To guage the importance of their effects in interface problems, the structure of a simple sum 5 twist boundary is examined, with the atoms described by both pair- and three-center interactions and as a function of the relative strength of the two. 15 refs.

42097 **(FEI—1791) Effect of dislocation elastic fields on equilibrium configurations of intrinsic point defects in cubic crystals. Iron bcc crystal.** Ivanov, V.V.; Chernov, V.M. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk. Fiziko-Ehnergeticheskij Inst.). 1986. 20p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703122/JAW.

Parameters of dislocation interaction with different configurations of an intrinsic interstitial (II) and vacancy in iron bc crystal are derived using elasticity anysotropy methods. Strong effect of dislocation strain elastic fields on the type of a stable II configuration is noted. Dislocation elastic strain fields stabilize II configurations unstable in their absence. Qualitative difference of II diffusion processes in elastic fields of edge and screw dislocations with Burgers vector b=a/2[111] is demonstrated. Crowdion configuration formation near the edge dislocation leads to interstitial "hovering" in its vicinity. Peculiarities of <111> stabilization of II dumbel configuration in the vicinity of screw dislocation with Burgers vector b=a[001] condition the possibility of realizing the complex (screw) type of interstitial migration in the vicinity of screw dislocation. Based on the results obtained, which comply with the data of computerized simulation of crystals with defects, the effect of radiation loss of strength of iron bcc crystals, conditioned by radiation-stimulated increase of mobility of screw dislocations with Burgers vector b=a/2[111], is explained. 13 refs.; 9 figs.; 4 tabs.

42098 **(FEI—1859) Investigation of lattice dynamics and interstitial vibrations of ME-(O,N) solid solutions on the base of transition metals of 4 group.** Morozov, S.I.; Sumin, V.V. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk. Fiziko-Ehnergeticheskij Inst.). 1987. 26p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703127/JAW.

Experimental results of studying the spectra of inelastically scattered neutrons by transition metals of the 4th group with O and N additions, are presented.A significant hardening of the matrix spectra in the case of introdicing oxygen atoms in Zr and Ti despite lattice dilation is observed. The dependence of interatomic interaction constant of metal-interstitial on the distance for the metals of the 4th group is plotted. The possibility of plotting the interaction potential as a function of dimensional discrepancy between the interstitial radius and the intestitial position radius is considered. The estimates given permit to suppose that the energy of high-frequency oscillation of oxygen and nitrogen atoms in vanadium is also determined by dimensional discrepancy of the interstitial radii and interstitial position. The reasons for impurity oscillation expansion are analyzed. It is shown that static fluctuation of metal-impurity distances conditioned by lattice deformation around interstitials contribute approx. 20-30 to their own width of the imparity level.

42099 **(IC—87/196) Optical absorption coefficient in cylindrical quantum wells.** Perez Alvarez, R.; Pajon Suarez, P. (International Centre for Theoretical Physics, Trieste (Italy); Pedagogical Inst., Havana (Cuba). Faculty of Physics). (International Centre for Theoretical Physics, Trieste (Italy)). Jul 1987. 12p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703150/JAW.

Using the envelope function approximation and a one-band model, the absorption coefficient of a quantum wire with arbitrary transverse section is studied. The selection rules for direct allowed transitions are reported. The results are particularized for the cylindrical case with infinite potential barrier and numerical results for GaAs are given. (author). 12 refs, 1 fig.

42100 **(IC—87/198) Electronic structure of light impurities in α-Fe and V.** Gong Xingao; Zeng Zhi; Zheng Wingqi. (International Centre for Theoretical Physics, Trieste (Italy); Academia Sinica, Hefei, AH (China). Inst. of Solid State Physics). (International Centre for Theoretical Physics, Trieste (Italy)). Jul 1987. 13p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702958/JAW.

The electronic structure of α-Fe and V with hydrogen and carbon as impurities is calculated using the embedded cluster models in the framework of self-consistent local density theory. The results obtained reveal that the charge transfer between the H atom and the host atom is small, but the magnetic moments of neighbouring Fe atoms are reduced. The total energy implies that hydrogen in α-Fe is more easily found to occupy the octahedral interstitial site. On the other hand, there is a charge transfer between the C atom and the host atoms. The distance between the carbon and the nearest neighbour iron atoms is 23% elongated. The interaction between the hydrogen and the carbon impurities was studied using a set of clusters of Fe/sub 10/CH in which the atoms were located in five kinds of configuration. The energy of clusters with hydrogen on octahedral interstitial site is lower than that on the tetrahedral interstitial site. (author). 10 refs, 6 figs, 2 tabs.

42101 **(IC—87/234) New approach to the theory of Heisenberg antiferromagnet at finite temperature.** Marvakov, D.I.; Kuzemsky, A.L. (International Centre for Theoretical Physics, Trieste (Italy); Joint Inst. for Nuclear Research, Dubna (USSR)). (International Centre for Theoretical Physics, Trieste (Italy)). Aug 1987. 9p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88703151/JAW.

A complete self-consistent finite temperature theory of spin waves with damping in antiferromagnets using the irreducible Green function method is developed. (author). 8 refs.

42102 **(IC—87/240) Theoretical study of EPR spectra in Cu/sup 2+/ - and Mn/sup 2+/ - doped CaCd(CH/sub 3/COO)/sub 4/.6H/sub 2/O.** Zhou Yiyang; Zhao Minguang. (International Centre for Theoretical Physics, Trieste (Italy); Sichuan Normal Univ., Chengdu (China). Inst. of Solid State Physics). (International Centre for Theoretical Physics, Trieste (Italy)). Aug 1987. 14p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702960/JAW.

The EPR spectra of CaCd(CH/sub 3/COO)/sub 4/.6H/sub 2/O doped with Cu/sup 2+/ and Mn/sup 2+/ have been studied theoretically. A comparison between the calculated results and the experimental data shows quantitatively that the Cu/sup 2+/ and Mn/sup 2+/ ions substitute for the Cd/sup 2+/ and Ca/sup 2+/ ions, respectively. This conclusion is consistent with the qualitative assumption given by previous authors. (author). 36 refs, 1 fig., 3 tabs.

42103 **(IC—87/245) Structure of the interface in the solvent mediated interaction of dipolar surfaces.** Dzhavakhidze, P.G.; Kornyshev, A.A.; Levadny, V.G. (Georgian Polytechnic Inst., Tbilisi (USSR). Dept. of General and Theoretical Physics; International Centre for Theoretical Physics, Trieste (Italy); AN SSSR, Moscow (USSR). Inst. of Cybernetics Problems). (International Centre for Theoretical Physics, Trieste (Italy)). Aug 1987. 31p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702962/JAW.

Interaction of two dipolar surfaces separated by a polar medium is considered within the framework of nonlocal electrostatics. The dipolar surface layers are modelled as regular lattices with fixed orientation of dipoles which are immersed into the solvent; solvent response is characterized by nonlocal dielectric function. The model is elaborated in order to reveal the role of the dipolar layer discreteness in the electric field produced by one surface and the interaction between two surfaces (which gives rise to the so called "hydration" or "structural" force acting between mineral surfaces and phospholipid bilayers). The discreteness effects are present only for commensurate lattices. Their special mutual arrangement then may lead to considerable reduction of structural forces, viz. the usual repulsion regime may change at short distances to attraction. Conditions are considered when repulsion is entirely replaced by attraction, i.e. the "hydration barrier" disappears. In appended note we discuss the role of solvation of surface dipolar groups. We propose an explanation of why two modes of decay (one with oscillative fine structure) may be present in the dependence of the force upon distance if the surface dipolar groups are immersed deep enough in the solvent and how the long-range oscillative mode disappears when the surface is but weakly solvated. (author). 35 refs, 5 figs.

42104 **(IC—87/262) Model for positron trapping and detrapping at dislocations and jogs.** Xiong, L.Y.; Lung, C.W. (International Centre for Theoretical Physics, Trieste (Italy)). Aug 1987. 20p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702978/JAW.

Using a modified trapping model which considers the detrapping effects and the trapping and annihilating effects at the dislocation lines themselves, the rate equations were suggested and solved. The calculated results were discussed. The lifetime of positron annihilation at the dislocation line in a deformed zinc single crystal was measured. (author). 9 refs, 5 figs.

42105 **(IC—87/266) Determination of the α-LiIO/sub 3/:Cr/sup 3+/ crystal structure from the EPR and optical spectrum.** Huang Ming. (International Centre for Theoretical Physics, Trieste (Italy)). Sep 1987. 5p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702980/JAW.

A qualitative estimate of the structure data of α-LiLO/sub 3/:Cr/sup 3+/ was given by M. Krupski. This paper determines the structure data of α-LiLO:Cr/sup 3+/ quantitatively from the high-order perturbation formulas, as well as the experimental data of EPR D-parameter and optical spectrum. Results of this calculation are in good agreement with the estimated value of M. Krupski. (author). 6 refs.

42106 **(IC—87/292) Mode coupling analysis of coherent quasi-elastic neutron scattering from fluorite-type materials approaching the superionic transition.** Chaturvedi, D.K.; Tosi, M.P. (International Centre for Theoretical Physics, Trieste (Italy)). Aug 1987. 12p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703153/JAW.

Neutron scattering experiments on SrCl/sub 2/, CaF/sub 2/ and PbF/sub 2/ have shown that intensity and width of the coherent diffuse quasi-elastic spectrum increase rapidly with temperature into the fast-ion conducting phase, the main feature in the integrated quasi-elastic intensity being a peak just beyond the (200) point along the (100) direction in scattering wave vector space. The Zwanzig-Mori memory function formalism is used in this work to analyze the quasi-elastic scattering cross section from charge density fluctuations in terms of anharmonic couplings between the vibrational modes of the crystal. The two- and three-mode channels are examined for compatibility with the quasi-elastic neutron scattering evidence, on the basis of (i) energy and momentum conservation and van Hove singularity arguments and (ii) measured phonon dispersion curves along the main symmetry directions in SrCl/sub 2/, CaF/sub 2/, SrF/sub 2/ and BaF/sub 2/. The analysis identifies a specific microscopic role for the Raman-active optic branches. The eigenvectors of the relevant Raman-active and partner modes in the three-mode channel describe relative displacements of the two halogens in the unit cell superposed on relative displacements of the halogen and alkaline earth components. This microscopic picture is thus consistent with the superionic transition being associated with the onset of dynamic disorder in the anionic component of the crystal. (author). 13 refs, 2 tabs.

42107 **(IC—87/315) Charge density waves and local states in quasi-one-dimensional mixed valence inorganic complexes.** Conradson, S.D.; Stroud, M.A.; Zietlow, M.H.; Swanson, B.I.; Baeriswyl, D.; Bishop, A.R. (Los Alamos National Lab., NM (USA)). (International Centre for Theoretical Physics, Trieste (Italy)). Oct 1987. 20p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702984/JAW.

The ground state structures and local states associated with chemical defects in quasi-one-dimensional halogen (X) bridged tran-

sition metal (M) mixed valence solids of MX and MMX type have been studied. An adiabatic Hartree-Fock theoretical framework is presented and representative members are classified. The MX materials provide a class whose strong electron-phonon coupling usually favors a charge-density-wave (CDW) ground state. However, the coupling strength can be chemically tuned (e.g., by extension to MMX systems) or altered by pressure, driving the ground state structures towards, e.g., a bond-order-wave (BOW) phase. Electron-phonon driven self-trapped states are expected in both the CDW or BOW regimes. Resonance Raman spectra of the MMX solid K/sub 4/(Pt/sub 2/(P/sub 2/O/sub 5/H/sub 2/)/sub 4/ Cl)center dotH/sub 2/O show, in addition to the homogeneous ground state modes, sharp new features with excitation profiles shifted to the red of the intervalence-charge-transfer (IVCT) band. We attribute these new bands to a local polaron state formed by oxidation of the Pt/sub 2/ Cl chain by a chemical defect. The observed spectral characteristics of this local state are in good agreement with theoretical predictions. (author). 28 refs, 4 figs, 1 tab.

42108 **(IC—87/372) Solution of the one-dimensional Hubbard model for arbitrary electron density and large U.** Carmelo, J.; Baeriswyl, D. (International Centre for Theoretical Physics, Trieste (Italy)). Oct 1987. 31p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702992/JAW.

The one-dimensional Hubbard model is studied for general electron densities and large U. On the basis of the coupled integral equations of Lieb and Wu exact asymptotic expansions are derived to fifth order in U/sup -1/ for the ground state energy, the kinetic energy and the number of doubly occupied sites. A closed-form expression for the distribution functions of charge and spin degrees of freedom is proposed which yields the same large U expansion as that derived directly from the Lieb-Wu equations. Our analytical results are in excellent agreement with previous numerical studies. (author). 30 refs, 6 figs, 3 tabs.

42109 **(IC—87/416) Interference effects in the nonlinear charge density wave dynamics.** Jelcic, D.; Batistic, I.; Bjelis, A. (Zagreb Univ. (Yugoslavia). Inst. of Physics). (International Centre for Theoretical Physics, Trieste (Italy)). Dec 1987. 48p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703017/JAW.

The main features of the nonlinear charge density wave transport in the external dc-ac field are shown to be the natural consequences of resonant phase slip diffusion. This process is treated numerically within the time dependent Landau-Ginzburg model, developed by Gor'kov. The resonances in the ac field are manifested as Shapiro steps in I-V characteristics, present at all rational ratios of internal frequency of current oscillations and external ac frequency. The origin of Shapiro steps, as well as their forms and heights, are cosidered in detail. In particular, it is shown that close to resonances the phase slip voltage acquires a highly nonsinusoidal modulation which leads to the appearance of low frequency and satellite peaks in the Fourier spectrum. Taking into account the interference of adjacent phase slips and the segment or domain structure of physical samples, we interpret the finite width of steps, side wings, synchronization, incomplete and complete mode locking and some other effects observed in numerous experiments on NbSe/sub 3/ and other CDW materials. (author). 36 refs, 12 figs.

42110 **(IC—88/54) Competition between direct interaction and Kondo effect: Renormalization-group approach.** Allub, R. (International Centre for Theoretical Physics, Trieste (Italy)). Mar 1988. 14p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703170/JAW.

Via the Wilson renormalization-group approach, the effect of the competition between direct interaction (J/sub L/) and Kondo coupling is studied, in the magnetic susceptibility of a model with two different magnetic impurities. For the ferromagnetic interaction (J/sub L/ $>$ 0) between the localized impurities, we find a magnetic ground state and a divergent susceptibility at low temperatures. For (J/sub L/ $<$ 0), two different Kondo temperatures and a non-magnetic ground state are distinguished. (author). 12 refs, 1 fig.

42111 **(INIS-BR—1114) Electron paramagnetic resonance of atomic hydrogen (H/sup 0/) centers in pink tourmaline from Brazil.** Camargo, M.B. (Sao Paulo Univ. (Brazil). Inst. de Fisica). 1985. 166p. (In Portuguese). NTIS (US Sales Only), PC A08/MF A01. Order Number DE88703215/JAW.

A model for explaining the atom of hydrogen (H/sup 0/) in pink tourmaline irradiated with gamma rays is presented. The concentration of H/sup 0/ was evaluated and the H/sup 0/ lines using the electron paramagnetic resonance were analysed. The g factor and the hyperfine interaction constant were measured with accuracy and determined by matrix diagonalization of spin hamiltonian in vetor space of four dimensions, followed by an iterative calculation with quick convergence the local electric field produced by charges in the lattice was calculated and compared with the value obtained experimentally. (M.C.K.).

42112 **(INIS-BR—1138) Study of optical absorption in the ultraviolet region of mixed crystals ADA/ADP aiming to investigate defects and centers formed by ionizing radiation.** Schneider, S. (Minas Gerais Univ., Belo Horizonte (Brazil)). 1978. 61p. (In Portuguese). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88703238/JAW.

The development of a crystal model to explain the ionizing radiation effect on the color centers is presented. The methods of crystal growth used in the sample preparation and the requirements necessary for an efficient optical study, such as area, thickness purity, etc, are described. The processes of color center production are analysed and the techniques used in the study of color centers, such as optical absorption, spectrometry and spin resonance, are described. The computer programs used in curve adjustment and the approximated calculation of centers per cm/sup 3/ are also presented. (M.C.K.).

42113 (INIS-SU—443, pp 53-58) **Effect of anisotropy of the surface of threshold energy displacement on the calculation of a cascade function.** Turkebaev, T.Eh. (AN Kazakhskoj SSR, Alma-Ata. Inst. Yadernoj Fiziki). 1987. (In Russian). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88780079/JAW.

Voprosy Atomnoj Nauki i Tekhniki.;No. 2.

In Physics of radiation damages and radiation science of materials.

The technique is developed and numerical solution of a cascade function for various directions of primary knocked-out atoms moving in monocrystals and amorphous substances is carried out. It is shown that in the first case the function depends on the direction of PVA escape and is of oscillating character, which is caused by the surface anisotropy of the shift threshold energy. In case of amorphous substances the results obtained are approximated by the analytical expression.

42114 (INIS-SU—443, pp 80-82) **Electroluminescence in dielectrics in the field of an injected charge.** Uvarov, V.L.; Moiseenko, B.I.; Protasyuk, G.N. (AN Ukrainskoj SSR, Kharkov. Fiziko-Tekhnicheskij Inst.). 1987. (In Russian). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88780079/JAW.

Voprosy Atomnoj Nauki i Tekhniki.;No. 2.

In Physics of radiation damages and radiation science of materials.

Electroluminescence (EL) excitation effect in generation of dipole domains in polymethylmethacrylate, being in a strong electric field ($>$or approx. 5x10/sup 5/ V/cm) of a space charge initiated by high-energy electron beam injection, has been experimentally detected. EL pulse has a high-frequency modulation related to the impact polarization of the domain region as a result of shock sound wave excitation.

42115 **(INIS-SU—443) Physics of radiation damages and radiation science of materials.** (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow). 1987. 93p. (In Russian). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88780079/JAW.

Individual papers have been indexed separately. (WRF)

42116 **(JINR-R—1-87-653) Use of a bent silicon crystal for deflection and formation of a proton beam with 8.9 GeV/c momentum.** Bel'zer, L.I.; Bodyagin, V.A.; Vardanyan, I.N. and others. (Moskovskij Gosudarstvennyj Univ. (USSR). Nauchno-Issledovatel'skij Inst. Yadernoj Fiziki). (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1987. 7p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88703379/JAW.

Submitted to the journal Zh. Tekh. Fiz. .

The deflecting properties of a bent silicon crystal by the planar channeling have been studied with the help of a one-shoulder magnetic spectrometer. The crystal has been used for the formation of a proton beam with a 8.9 GeV/c momentum. 12 refs.; 5 figs.

42117 **(KFKI—1987-78/E) Accelerator produced beta-active nuclei in materials science.** Tompa, K. (Hungarian Academy of Sciences, Budapest. Central Research Inst. for Physics). Dec 1987. 33p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703432/JAW.

The concepts of beta-NMR are introduced by means of comparing it with classical NMR and muon spin rotation spectroscopy. The interactions of beta-active nuclei characterized by magnetic dipole and electric quadrupole moments and electromagnetic fields inherent in solids hold information through nuclear energy levels about the product of nuclear moments and electromagnetic fields existing at the position of nuclei within a highly localized region around them. The investigation of these interactions yields information on both the nuclear moments and the solid-state physical parameters of the symmetry, the defects and electronic structure. These examples are discussed in detail from the newer applications of beta-NMR in the field of materials science. Conclusions of these examples are characteristic of all metals. (D.Gy.) 19 refs.; 5 figs.; 4 tabs.

42118 **(KIYI—87-29) Peculiarity of deep level appearance in highly compensated p-Ge<Ga,Li> in the process of Li ions dropout.** Gavrilyuk, B.I.; Kirnas, I.G.; Litovchenko, P.G.; Petrosyan, Eh.E.; Pashchuk, N.N.; Nederya, S.V. (AN Ukrainskoj SSR, Kiev. Inst. Yadernykh Issledovanij). 1987. 18p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703450/JAW.

Temperature dependence of free charge carrier concentration in the process of isothermal annealing of p-Ge samples doped with Ga and Li atoms compensated by Li/sup +/ ion drift in electric field of inversaly shifted p-n transition is studied. It is proved that Li ions in germanium volume form metastable coulomb pairs with acceptor centers which do not exchange carriers with resolution band. 20 refs.; 4 figs.; 1 tab.

42119 **(KU-HCOE-FL2-R—86-15) Computer simulations of atomic collisions in solids with special emphasis on sputtering.** Andersen, H.H. (Copenhagen Univ. (Denmark). H.C. Oersted Inst.). 1986. 85p. (CONF-8606191—). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88752680/JAW.

From International symposium on sputtering; Vienna, Austria (2 Jun 1986).

Computer simulations of atomic collisions in solids are traditionally divided into fully interacting or molecular dynamics (MD) simulations on the one side and simulations based on the binary collision approximation (BCA) on the other. The historical development of both branches is followed and other dichotomies viz. between static and dynamic target models and between models using crystalline and amorphous targets are introduced. The influence of the main input parameters, viz. interatomic potentials, surface- and bulk-binding energies and inelasticity is discussed before selected results are treated. Here, results for non-linear effects, clusters, fluctuations and for angular distributions are presented. The review is concluded with a discussion of the influence of computer developments on future simulations. With 392 refs..

42120 **(PB—88-864269/XAB) Magic-angle-spinning NMR spectroscopy. January 1978-May 1988 (Citations from the INSPEC: Information Services for the Physics and Engineering Communities data base). Report for January 1978-May 1988.** (National Technical Information Service, Springfield, VA (USA)). May 1988. 52p. NTIS PC N01/MF N01.

This bibliography contains citations concerning the principles and applications of magic-angle spinning (MAS) nuclear magnetic resonance (NMR) in high-resolution spectra analysis of solids. Magic-angle spinning NMR is a very powerful spectrographic technique for the study of structures, dynamics, and reactivity of solids, and polcrystalline and amorphous solids. Studies of various materials are presented, including zeolites, organic compounds and polymers, liquid crystals, silicate and borate glasses, and alumina and oxide films. Applications in conductive polymers, biological systems, and organic matrixes of composite materials are presented. (Contains 89 citations fully indexed and including a title list.)

42121 **(PUC-TN—08/84) Bootstrap percolation: a renormalisation group approach.** Branco, N.S.; Santos, Raimundo R. dos; Queiroz, S.L.A. de. (Pontificia Univ. Catolica do Rio de Janeiro (Brazil). Dept. de Fisica). Feb 1984. 12p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703472/JAW.

In bootstrap percolation, sites are occupied at random with probability p, but each site is considered active only if at least m of its neighbours are also active. Within an approximate position-space renormalization group framework on a square lattice we obtain the behaviour of the critical concentration p (sub)c and of the critical exponents ν and β for m = 0 (ordinary percolation), 1,2 and 3. We find that the bootstrap percolation problem can be cast into different universality classes, characterized by the values of m.

42122 **(PUC-TN—12/84) Dimensional crossover in directed percolation.** Chame, A.M.N.; Queiroz, S.L.A. de; Santos, Raimundo R. dos. (Pontificia Univ. Catolica do Rio de Janeiro (Brazil). Dept. de Fisica). Apr 1984. 9p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88703473/JAW.

We study the dimensional crossover in directed percolation in three dimensions. Bonds are allowed to have different concentrations along the three cartesian axes of the lattice. Through a Position Space Renormalization Group we obtain the phase-diagrama where non-percolating, 1-D, 2-D and 3-D percolating phases are present. We find that the isotropic fixed points are unstable with respect to anisotropy, thus driving the system into a different universality class.

42123 **(RAL—88-037) SIMPLANT: analytic calculation of ion implantation within the Tadpance system.** Fawcett, R.J. (Rutherford Appleton Lab., Chilton (UK)). Apr 1988. 20p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88754101/JAW.

An analytic method for calculating the concentration distribution of dopant atoms introduced into a multilayer semiconductor device by ion beam implantation is explained. Computer software written to apply the method is described. The operation of the software within a semiconductor process and device modelling package is outlined. Implantation distributions generated by the software are illustrated.

42124 **(SAND—88-0913C) Reactive ion etching of laser structures.** Vawter, G.A. (Sandia National Labs., Albuquerque, NM (USA)). 1988. Contract AC04-76DP00789. 12p. (CONF-880311—2). NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88008470/JAW.

From Advances in semiconductors and superconductors: physics and device applications; Newport Beach, CA, USA (13 Mar 1988).

In recent years interest in dry-etch processing of laser structures has grown dramatically. Reactive-ion-etching (RIE) has developed from a high resolution pattern transfer technique for silicon integrated circuit processing into a successful method for fabricating the smooth, vertical facets required by double heterostructure (DH) lasers. However, in addition to RIE several other new plasma

processes have been developed and applied to the development of dry etched laser structures. This paper reviews the motivations behind this work, provides some examples of recent developments in the field of dry-etching as applied to DH laser structures and attempts to point out some of the problems associated with dry etching of optoelectronic devices. 19 refs., 4 figs.

42125 **(UCRL—96635-Rev.1) Analysis of sputter coating uniformity by computer modeling.** Upadhye, R.S.; Kong, M.K.; Hsieh, E.J. (Lawrence Livermore National Lab., CA (USA)). 26 Oct 1987. Contract W-7405-ENG-48. 11p. (CONF-871125—24-Rev.1). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88011739/JAW.

From 34. national vacuum symposium and topical conference; Anaheim, CA, USA (2 Nov 1987).

Sputter coating is usually the method of choice for depositing thin films when non-planar substrates are involved. The higher gas pressure used in sputtering enhances the scattering of the coating flux, thus leading to a better step coverage. Coating uniformity is a major concern in experiments related to laser fusion. Vessel walls and bottom, called ground plane in this paper, affect coating nonuniformity. Any sputtered atoms hitting these surfaces will, in general, stick to them. This, in turn, may affect the flux distribution at the substrate if the two are close to each other. We have modeled the effect of the ground plane on the deposition uniformity on the substrate. We have also measured these effects experimentally and compared them to the results obtained from the model. 4 refs., 2 figs., 2 tabs.

42126 **(UNB-FIS—15/87) Phonon amplification by absorption of laser field in a semiconductor with a superlattice.** Nunes, O.A.C. (Brasilia Univ. (Brazil). Dept. de Fisica). Sep 1987. 11p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88701711/JAW.

We investigate here the possibilities amplification of phonons in a semiconductor superlattice be free carriers due to the absorption of laser radiation.

42127 **(UNB-FIS—16/87) Low-lying excited states, magnetic ordering and the phenomenology of the half-filled narrow band metal-insulator transition at low temperature.** Ferraz, A. (Brasilia Univ. (Brazil). Dept. de Fisica). Sep 1987. 9p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88701712/JAW.

A phenomenological theory is set up to take proper account of low lying excited states in the vicinity of the metal-insulator transition in a half-filled narrow band at low temperature. The electronic specific heat is calculated and it is shown to diverge as (1-U/ U/sup */) /sup -1/. Antiferromagnetic ordering effects in the enhancement factor of the spin susceptibility is also discussed.

42128 **(UNB-FIS—19/87) Reciprocal propagation of surface modes in an antiferromagnetic film.** Oliveira, F.A.; Amato, M.A. (Brasilia Univ. (Brazil). Dept. de Fisica). Sep 1987. 10p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88701714/JAW.

Linear response theory is used to evaluate the Green's functions describing the fluctuations in an antiferromagnetic film at zero applied field. It is shown the similarities between the dielectric and magnetic excitations.

42129 **Cluster multiple-scattering theory for medium-energy electron diffraction.** Barton, J.J.; Xu, M.; Van Hove, M.A. (Materials and Chemical Sciences Division, Lawrence Berkeley Laboratory, Berkeley, California 94720). *Physical Review [Section] B: Condensed Matter;* **37**: No. 18, 10475-10486(15 Jun 1988).

A theory of medium-energy (100—5000-eV) electron diffraction (MEED) is developed from a multiple-scattering, curved-wave theory of photoelectron diffraction. It may be called "near-field expansion in clusters." Only selected important scattering events are included and these are computed in times proportional to electron wave number by using a generalized scattering-factor method (conventional low-energy electron-diffraction methods require computations proportional to at least the fourth power of the wave number, while the "chain" method for MEED scales as at least the square of the wave number). This removes the most serious barrier to a multiple-scattering analysis for surface-structure determination. A direct summation over atoms and scattering paths is used, avoiding any assumptions of periodicity in the surface structure. The theory allows a clearer understanding of the relationship between diffraction intensities and surface structure than heretofore possible.

42130 **Precipitate shape evolution under applied stress - Thermodynamics and kinetics.** Johnson, W.C. (Dept. of Metallurgical Engineering and Materials Science, Carnegie Mellon Univ., Pittsburgh, PA (US)). *Metallurgical Transactions, [Section] A: Physical Metallurgy and Materials Science;* **18A**: No. 2, 233-248(Feb 1987).

The influence of an external stress field on the growth and morphological evolution of a coherent precipitate is examined within the context of the thermodynamics of crystalline solids and interfaces. Equilibrium interfacial concentrations are obtained that are shown to be strong functions of position along the precipitate-matrix interface. These variations in concentration may be larger than the usual capillarity term and are a result of elastic considerations and not a result of changes in the local interfacial curvature. The interfacial concentrations directly influence the precipitate growth rate and result in changes in the precipitate morphology. Depending upon the signs and magnitudes of the coherency strains, the applied stress field and the elastic inhomogeneity of the system, the shape evolution may be approximated by ellipsoids of revolution.

42131 **Capillary forces between spheres during agglomeration and liquid phase sintering.** Hwang, K.S.; German, R.M.; Lenel, F.V. (Power Semiconductor Div., General Instrument Corp., 600 West John Street, Hicksville, NY (US)). *Metallurgical Transactions, [Section] A: Physical Metallurgy and Materials Science;* **18A**: No. 1, 11-18(Jan 1987).

The capillary force due to a wetting liquid between solid particles has been calculated for several situations using a numerical technique. Included are variations in particle size, contact angle, liquid volume, and particle separation. The capillary force obtained from these calculations is more accurate than prior estimates using a circular profile for the interparticle liquid bridge. A large attractive force exists between particles with small contact angles, particle sizes, and liquid volumes. Rupture of the liquid-bridge is predicted using an energy analysis. At large contact angles, a zero force condition exists at an intermediate particle separation.

42132 **Numerical simulations of small projectiles impacting a multilayered target at hypervelocities.** Meier, R.W. (Los Alamos National Lab., Los Alamos, NM (US)). pp 471-482 of Hypervelocity impact. Anderson, C.E. Elmsford, NY; Pergamon Books Inc. (1987). (CONF-861091—).

From Hypervelocity impact symposium; San Antonio, TX, USA (21 Oct 1986).

The effects of a hypervelocity (10-80 km/s) projectile of low mass (1 and 5 g) striking a multilayered target have been investigated. The two-dimensional numerical simulation was done with the Eulerian hydrodynamics computer program LASOIL. Target responses that were calculated include the time variant material deformation, pressures, shock-wave movement, and hole sizes. Parametric studies were done to determine the effects of projectile mass, velocity, and shape on target response as measured by these parameters.

42133 **A simple defense conservative model for mass requirements of hypervelocity projectile impact shields for reentry vehicles.** Spillman, G.R. (Los Alamos National Lab., Los Alamos, NM (US)). pp 595-602 of Hypervelocity impact. Anderson, C.E. Elmsford, NY; Pergamon Books Inc. (1987). (CONF-861091—).

From Hypervelocity impact symposium; San Antonio, TX, USA (21 Oct 1986).

Simple analytical modeling of the physics of interaction of hypervelocity (50-100 km/s) projectiles with a bumper shield countermeasure is given. The interaction of projectile and bumper is discussed briefly. Expansion of bumper/projectile debris in the region between bumper and underlying vehicle and interaction of bumper/

projectile debris cloud with a vehicle are examined. Expansion of debris is treated as an expansion superimposed upon a translation with partition derived from a simple inelastic collision model. The effect of nonunity aspect ratio of compressed debris is included. Debris colliding elastically with the vehicle will impart momentum equal to twice the incident normal component. A steady-state diffusion model is used to estimate the effect of stagnation radiative loss on collision elasticity. Impulse may be reduced up to a factor of 2 by stagnation radiative loss on collision elasticity. Impulse may be reduced up to a factor of 2 by stagnation radiative losses for small projectiles and large bumper/vehicle stand-off. Stagnation radiation loss is small for larger projectile and smaller stand-off. Impulse can be enhanced by vehicle ablation from radiative coupling, shock heating (inadequate stand-off), or liquid droplet microcratering (inadequate bumper thickness). Estimates of required bumper mass are given for a specific example.

42134 **Low temperature deposition by laser induced breakdown in the vapor phase.** Jervis, T.R.; Joyce, E.L. Jr. (Materials Science and Technology Div., Mailstop E549, Los Alamos National Lab., Los Alamos, NM (US)). pp 877 of Proceedings of the tenth international conference on chemical vapor deposition, 1987. Cullen, G.W. Pennington, NJ; The Electrochemical Society (1987). (CONF-8710183—).

From 10. international conference on chemical vapor deposition; Honolulu, HI, USA (1 Oct 1987).

The authors developed a new technique for deposition on low temperature substrates driven by gs laser induced dielectric breakdown of gas phase precursors. Metal films of Ni, Fe, and refractory metal alloys show excellent grain refinement (< 10 nm) and metastable phase incorporation due to rapid quenching from the gas phase. The technique, including the role of gas phase nucleation and growth in the formation of the films, the microstructures obtained, and some of the properties of the films are described.

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REFER ALSO TO CITATION(S) 40316, 40369, 40371, 40378, 40383, 40390, 41716

42135 **(BNL—41032) Theory of oxygen ordering and absorption in 1,2,3 high-T/sub c/ superconductors.** Westerveld, J.P.A.; Lo Cascio, D.M.R.; Bakker, H.; Welch, D.O. (Brookhaven National Lab., Upton, NY (USA); Amsterdam Univ. (Netherlands). Natuurkundig Lab.). 1988. Contract AC02-76CH00016. 4p. (CONF-880207—1). NTIS, PC A02/MF A01;1; GPO Dep. Order Number DE88007543/JAW.

From Discussion meeting on high-{Tc} superconductors; Mauterndorf, Austria (7 Feb 1988).

The oxygen content and the oxygen ordering in 1,2,3 high T/sub c/ compounds plays an important role in the superconducting properties of these materials. Experiments show that the absorption and desorption of oxygen mainly occurs in the CuO planes, that are located at maximum distance from the trivalent ion and that the ordering of the oxygen atoms in linear Cu-O-Cu-O-chains in these planes leads to the orthorhombic structure at lower temperatures. Full occupancy of the oxygen positions in these chains along the direction of the b axis leads to 7 oxygen atoms per formula unit. Complete order means that all oxygen positions in the perpendicular direction (along the a axis) are vacant. Disordering in combination with oxygen desorption causes the orthorhombic to tetragonal phase transition at high temperatures. In the tetragonal phase with about 6.5 oxygen atoms per formula unit the oxygen atoms are distributed over the 'b' and 'a' positions in equal amounts. This causes the a and b lattice parameters to be equal and leads to the tetragonal phase. 8 refs., 6 figs.

42136 **(CEA-CONF—9180) Specific heat at low temperatures: experimentation and current themas at CENG.** Bonjour, E.; Calemczuk, R. (CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France). Dept. de Recherche Fondamentale). 1986. 20p. (In French). (CONF-8609434—1). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88770218/JAW.

From Seminar on heat capacities in condensed matter; Cadarache, France (25 Sep 1986).

After a recall on what properties specific heat measurements allow to know in solid physics and on experimental devices at CENG (CEA-Grenoble), some current studies are overviewed: disordered systems, magnetism study in rare earth compounds and actinides, and superconductors (heavy fermion compounds and cluster ternary superconductor compounds).

42137 **(IC—87/281) New quantum interferometer effect in superconducting oxide ceramics.** Chela Flores, J.; Shehata, L.N. (International Centre for Theoretical Physics, Trieste (Italy)). Aug 1987. 11p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703152/JAW.

On the basis of a phenomenological approach to type II high T/sub c/ superconductivity, we suggest that in the lanthanum compounds the Mercereau effect for a coupled junction pair should display and ex-dependent shift in the period of modulation of the tunnelling current. (author). 14 refs.

42138 **(IC—88/3) Possible coexistence of antiferromagnetism and superconductivity in the Hubbard model.** Su Zhaobin; Dong Jinming; Yu Lu; Shen Juelian. (International Centre for Theoretical Physics, Trieste (Italy); Academia Sinica, Beijing, BJ (China). Inst. of Physics). (International Centre for Theoretical Physics, Trieste (Italy)). Jan 1988. 9p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88703025/JAW.

The Hubbard model in the nearly half-filled case was studied in the mean field approximation using the effective Hamiltonian approach. Both antiferromagnetic order parameter and condensation of singlet pairs were considered. In certain parameter ranges the coexistence of antiferromagnetism and superconductivity is energetically favourable. Relevance to the high temperature superconductivity and other theoretical approaches is also discussed. (author). 10 refs, 3 figs.

42139 **(IC—88/21) Simple model for the superconducting phase diagram near the metal-insulator transition.** Allub, R.; Wiecko, C.; Caro, A. (International Centre for Theoretical Physics, Trieste (Italy)). Jan 1988. 20p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703038/JAW.

We solve a simple model of competing superconductivity and disorder in a mean-field approximation with two order parameters. A phase diagram showing superconducting-normal metal-insulator as well as superconducting-insulator transitions is obtained. Comparison with experiments shows a good qualitative agreement. (author). 25 refs, 2 figs.

42140 **(IC—88/58) Are spin-Peierls tendencies helping superconductivity?.** Tosatti, E.; Yu Lu. (International Centre for Theoretical Physics, Trieste (Italy)). Mar 1988. 6p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88703171/JAW.

Using mappings between one-dimensional models, we argue in this note that any additional spin-lattice to the Hubbard model and the ensuing tendency towards spin-Peierls state is damaging, rather than favourable to the RVB-type superconductivity. (author). 10 refs.

42141 **(JINR-R—8-87-526) Current-induced quantum interference in the composite superconductor NbTi-Cu.** Fisher, Eh.; Khukhareva, I.S. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1987. 14p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703079/JAW.

Submitted to the journal ZhEhTF and to the International Conf. on Physics of Low Temperature, Budapesht, 1987.

The I-V-curves for the transversal zero-bias resistance of a NbTi-Cu multifilamentary superconductor have been measured at 1.85 K in the presence of a weak dc-magnetic field (<or approx. 0.2 Oe) aligned along the NbTi-filaments perpendicular to the current flow. An oscillating dependence of both the critical current and the resistivity behaviour from the magnetic field amplitude has been obtained. These oscillations are in excellent agreement with the periodic dependence of the frustration parameter on magnetic

flux per unit cell determined by the geometry of the effective two-dimensional structure of the filament lattice. A detailed analysis of the vortex mobility reveals the strong vortex interaction in the critical region of the topological phase transition caused by the annihilation of the thermally activated vortex-pairs. The experimental results demonstrate the complete scaling properties of the obtained non-linear and quantum interference effects. 12 refs.; 8 figs.; 1 tab.

42142 (KFTI—87-44) Forces and energy dissipation in inhomogeneous non-equilibrium superconductors. Poluehktov, Yu.M.; Slezov, V.V. (AN Ukrainskoj SSR, Kharkov. Fiziko-Tekhnicheskij Inst.). 1987. 8p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88703444/JAW.

The phenomenological theory of volume forces and dissipation processes in inhomogeneous non-equilibrium superconductors near temperature transition from the normal to superconducting state is constructed. The approach is based on application of dynamic equations of superconductivity formulated on the basis of the Lagrangian formalism. These equations are generalized the Ginzburg-Landau theory in the nonstationary non-equilibrium case for "foul" superconductors. The value estimations of volume forces arising in inhomogeneities during relaxation of an order parameter and when the electrical field is penetrated into the superconductor, are given. 15 refs.

42143 (KU-HCOE-FL2-R—88-4) Asymmetry in the normal-metal to high-T/sub c/ superconductor tunnel junction. Flensberg, K.; Hedegaard, P.; Brix, M. (Danmarks Tekniske Hoejskole, Lyngby. Fysisk Lab. 1). (Copenhagen Univ. (Denmark). H.C. Oersted Inst.). 1 Mar 1988. 8p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88754031/JAW.

We show that the observed asymmetry in the I-V characteristics of high-T/sub c/ material to normal metal junctions can be explained within the Resonating-Valence-Bond model. For a bias current with electrons moving from the superconductor to the normal metal the current is quadratic in the bias voltage, and in the opposite case with electrons moving from the normal metal to the superconductor the current is linear in V.

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REFER ALSO TO CITATION(S) 40623, 41867, 41874, 41918, 42042, 42495

42144 (AD-A—191560/2/XAB) Random Schroedinger equation: white noise model. Balakrishnan, A.V. (California Univ., Los Angeles (USA). Dept. of Electrical Engineering). Jan 1988. 23p. (UCLA-ENG—0675). NTIS, PC A03/MF A01.

Pub. in Differential and Integral Equations, Vol. 1, No. 1, 49-70(Jan 1988).

This paper is essentially an application of the author's theory of abstract stochastic bilinear equations to the problem of laser-beam propagation in a turbulent medium, and the associated random Schroedinger equation. The white noise theory is shown to provide a consistent self-contained model for the Markov approximation of the refractive index field, and in particular avoids invoking ad hoc Stratanovich correction terms.

42145 (CBPF-NF—022/87) Biogenesis and the growth of DNA-like polymer chains: a computer simulation. Herrmann, H.J.; Tsallis, C. (Centre d'Etudes Nucleaires de Saclay, Gif-sur-Yvette (France). Service de Physique Theorique). (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro). 1987. 30p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703101/JAW.

We study, through computer simulation, a crucial step of Biogenesis, namely the growth of self-replicating codified DNA-like polymers starting from a mixture of oligomers. We have adopted the growth scheme that has been recently proposed by Ferreira and Tsallis which incorporates usual ideas of autocatalysis through complementary pairs and within which a central role is played by the hydrogen-like links (characterized by the probabilities p/sub AT/ and p/sub CG/ of chemical bonding of the A-T and C-G pairs respectively) between the two chains of the growing polymer. We find that the average equilibrium polymeric length ξ diverges, for any fixed ratio (1-p/sub AT/)/(1-p sub (CG)), as ξ proportional to 1/r1-p/sub AT/. Selection of patterns may happen at all stages and in particular at chemical equilibrium. Selection occurs via two different mechanisms: (i) away from the critical point p/sub AT/ = p/sub CG/ = 1 if p/sub AT/ not = p/sub CG/; (ii) both on and away from the critical point if the initial concentrations of nucleotides (A, T, C and G or their precursors) are different.

42146 (CBPF-NF—028/87) Equation of states of the Potts ferromagnet in anisotropic square lattice: renormalization group approach. Chame, A.M.N.; Tsallis, C.; Costa, U.M.S. (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro; Alagoas Univ., Maceio (Brazil). Dept. de Fisica). (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro). 1987. 25p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703103/JAW.

We extend to the anisotropic case (not necessarily equal coupling constants along the various crystalline directions) the real space renormalization group procedure recently introduced by Caride and Tsallis, which directly yields the order parameter for arbitraty temperatures. The method does not demand the calculation of the thermodynamic energy, it is as simple as a mean field calculation although it provides non trivial results, which can be systematically improved. Within the present extension, the coordination number of any given site is generalized into a suitable average of the coupling constants involving that site. We apply the procedure to the q-state Potts ferromagnet in anisotropic square lattice, whose exact equation of states is still unknown. Whenever possible, the results compare satisfactorily with available exact results.

42147 (CBPF-NF—052/87) Disordered D-vector model: mean field renormalization group treatment. Lyra, M.L.; Coutinho, S. (Pernambuco Univ., Recife (Brazil). Dept. de Fisica). (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro). 1987. 43p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703107/JAW.

The mean field renormalization group is applied to study critical temperatures of the quenched (F, AF and SG phases) and annealed (F and AF phases) disordered D-vector model. The phase diagrams, critical temperature against concentration are analytically calculated, plotted and analyzed for the Ising (D=1), Heisenberg (D=3) and D -> ∞ cases for several values of the competing parameter and coordination number for a particular distribution function. Reentrancies and limiting slope at pc of the ferro and antiferromagnetic boudaries are studied in detail. The present results are strictly equivalent to the exact results on the Bethe lattice. (M.W.O.).

42148 (CBPF-NF—062/87) Possible generalization of Boltzmann-Gibbs statistics. Tsallis, C. (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro). 1987. 20p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703108/JAW.

Using the quantity normally scaled in multifractals we postulate a gen eralized form for the entropy, namely S/sub q/ ident to K [1 - Σ/sub Wi=1/ p/sub iq/]/(q-1), where q is "an element of" R characterizes the generalization and { p/sub i/ } are the probabilities associated with W (microscopic) configurations (W is an element of N). We establish the main properties associated with this entropy, in particular those corresponding to the microcanonical and canonical ensembles. The Boltzmann-Gibbs statistics is recovered as the q -> 1 limit.

42149 (CRN-PN—86-22) Approach method of the solutions of algebraic models of the N body problem. Dufour, M. (Strasbourg-1 Univ., 67 (France). Centre de Recherches Nucleaires). Sep 1986. 217p. (In French). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88752400/JAW.

We have studied a class of algebraic eigenvalue problems that generate tridiagonal matrices. The Lipkin Hamiltonian was chosen as representative. Three methods have been implemented, whose extension to more general many body problems seems possi-

ble I) Degenerate Linked Cluster Theory (LCT), which disregards special symmetries of the interaction and defines a hierarchy of approximation based on model spaces at fixed number of particle-hole excitation of the unperturbed Hamiltonian. The method works for small perturbations but does not yield a complete description. II) A new linearization method that replaces the matrix to be diagonalized by local (tangent) approximations by harmonic matrices. This method generalizes LCT and is a posteriori reminiscent of semiclassical ones. However of is simpler, more precise and yields a complete description of spectra. III) A global way to characterize spectra based on Gershgorine-Hadamard disks.

42150 (IC—87/251) Canonical formalism and equations of motion for a spinning particle in general relativity. Tauber, G.E. (International Centre for Theoretical Physics, Trieste (Italy)). Aug 1987. 13p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702967/JAW.

A canonical formalism for spinning particles suitable for the formulation of a general relativistic covariant statistical mechanics of particles endowed with spin has been developed. For that purpose the bracket for internal and external variables has been given. In particular, limiting ourselves to the spin tensor S/sup $\mu\nu$/ it has been possible to define momenta which are the true conjugates to the position variables. For the case considered the Hamiltonian function in addition to the invariant "mass" involves only one additional scalar. The equations of motion are then found by calculating the brackets of the dynamical variables with that Hamiltonian, and are compared to those obtained by other methods. The conjugate variables in the internal space which has to be adjoined to the (eight-dimensional) phase space for a complete covariant description of spinning particles have also been given. (author). 22 refs.

42151 (IC—87/259) Quasi-linearization and three-dimensional oscillators. Jameel, M. (International Centre for Theoretical Physics, Trieste (Italy)). Aug 1987. 7p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702975/JAW.

The anharmonic symmetric oscillator is a frequently used model for physical systems. The recently developed quasi-linearization technique is applied to this model as well as to the simpler one without the quartic term in the potential. (author). 5 refs.

42152 (IC—87/261) On the construction of a class of abundant semigroups. El-Qallali, A. (International Centre for Theoretical Physics, Trieste (Italy)). Sep 1987. 22p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702977/JAW.

A method of characterizing a class of semigroups is described and a structure theorem for this class of semigroups is given. This class of semigroups consists of all abundant semigroups S in which the set of idempotents generates a regular subsemigroup and possesses a normal medial idempotent u such that uSu is a type A semigroup. (author). 9 refs.

42153 (IC—87/267) Inhomogeneities in a Friedmann universe. Tauber, G.E. (International Centre for Theoretical Physics, Trieste (Italy)). Aug 1987. 7p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702981/JAW.

One of the outstanding problems in cosmology is the growth of inhomogeneities, which are characterized by an anisotropic pressure and density distribution. Following a method developed by McVittie (1967, 1968) it has been possible to find time-dependent spherically symmetric solutions of Einstein's field equations containing an arbitrary pressure and density distribution which connect smoothly to a Friedmann universe for any desired equation of state. (author). 5 refs.

42154 (IC—87/310) Approximation of convex bodies by parallelotopes. Balla, M.Y. (International Centre for Theoretical Physics, Trieste (Italy)). Nov 1987. 5p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702982/JAW.

For a convex body A is contained in E/sup n/ let rho(A) denote the smallest positive λ such that P is contained in A is contained in Q for some parallelotope P and its homothetic copy Q with ratio λ. It is proved that rho(A) $\leq$ n for every convex body A is contained in E/sup n/ with the equality for simplices. We conjecture that the equality characterizes simplices and confirm that for n=2. (author). 5 refs.

42155 (IC—87/311) Approach to the structure of quasi-analytic classes. Balla, M.Y. (International Centre for Theoretical Physics, Trieste (Italy)). Nov 1987. 7p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702983/JAW.

An investigation has been carried out on the structural approach to some quasi-analytic classes in a homogeneous Banach space B, defined on M=T, based on the study of the ways in which properties of classes of functions are reflected by the Fourier series. 6 refs.

42156 (IC—87/314) Trivialization of constraints in the quantum theory (Working in a general gauge/parametrization). Shiekh, A.Y. (International Centre for Theoretical Physics, Trieste (Italy)). Oct 1987. 15p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703154/JAW.

A way is found to trivialize and so deal with constraints in a gauge invariant manner. (author). 18 refs.

42157 (IC—87/330) On the buckling of magnetothermoviscoelastic plate and an associated quadratic operator bundle. El-Sayed, M.A. (International Centre for Theoretical Physics, Trieste (Italy)). Oct 1987. 14p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703155/JAW.

The paper is devoted to the application of the theory of quadratic self-adjoint operator bundles to investigate the problem of oscillations and stability of an isotropic homogeneous, thermoviscoelastic ferromagnetic plate of arbitrary shape, small constant thickness and infinite electric conductivity, placed in a transverse uniform constant magnetic field and clamped along its whole boundary. 14 refs.

42158 (IC—87/358) Inner product for a Banach-algebra. Noor, M.; Verjovsky, A. (International Centre for Theoretical Physics, Trieste (Italy)). Oct 1987. 11p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703156/JAW.

An intrinsic inner product for a commutative Banach*-algebra is defined. Several conditions for its completeness are established. It is shown that any Banach*-algebra with proper and continuous involution has an auxiliary norm that turns it into an A*-algebra. (author). 7 refs.

42159 (IC—87/359) Quasi-adequate semigroups. El-Qallali, A. (International Centre for Theoretical Physics, Trieste (Italy)). Nov 1987. 19p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703157/JAW.

The least fundamental adequate good congruence on an arbitrary type W semigroup S is described as well as the largest superabundant full subsemigroup of S and the largest full subsemigroup of S which is a band of cancellative monoids. Weak type W semigroups are defined by replacing the idempotent-connected property in type W by one of its consequences and a structure theorem is obtained for such semigroups. (author). 12 refs.

42160 (IC—87/360) Second order parabolic equations for flow-domains. Duong Minh Duc. (International Centre for Theoretical Physics, Trieste (Italy)). Nov 1987. 14p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703158/JAW.

Using Poincare weighted inequality we study semigroups corresponding to elliptic operators degenerate in Trudinger's sense. Our results may be applied to the cases in which the domain and coefficient functions are nonsmooth and unbounded. (author). 11 refs.

42161 **(IC—87/366) Algebra of pseudo-differential C/sup */-operators.** Mohammad, N. (International Centre for Theoretical Physics, Trieste (Italy)). Nov 1987. 13p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702987/JAW.

In this paper the algebra of pseudo-differential operators is studied in the framework of C/sup */-algebras. It is proved that every pseudo-differential operator of order m admits an adjoint operator, in this case, which is again a pseudo-differential operator. Consequently, the space of all pseudo-differential operators on a compact manifold is an involutive algebra. 10 refs.

42162 **(IC—87/367) Naturally ordered abundant semigroups.** El-Qallali, A. (International Centre for Theoretical Physics, Trieste (Italy)). Nov 1987. 21p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702988/JAW.

An investigation of ordered abundant semi-groups S is made on which R-bar/sup */ and L-bar/sup */ are regular and the order of S extends the natural order on the set E of idempotents of S, where E generates a regular subsemi-group. Structure theorems are obtained when S contains a greatest idempotent u such that uSu is a type A monoid and when S has a multiplicative type A transversal such that every δ-class in S contains a maximum element. (author). 20 refs.

42163 **(IC—87/368) Abundant semigroups with a multiplicative type A transversal.** El-Qallali, A. (International Centre for Theoretical Physics, Trieste (Italy)). Nov 1987. 25p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702989/JAW.

A complete description is given for the structure of a class of semigroups consisting of all abundant semigroups S in which the set of idempotents generates a regular subsemigroup such that S contains a multiplicative type A transversal. (author). 10 refs.

42164 **(IC—87/371) Nonlinear perturbations of differential operators with nontrivial kernel and applications to third order periodic boundary value problems.** Afuwape, A.U.; Omari, P.; Zanolin, F. (International Centre for Theoretical Physics, Trieste (Italy); Trieste Univ. (Italy). Dipt. di Scienze Matematiche; International School of Advanced Studies, Trieste (Italy)). (International Centre for Theoretical Physics, Trieste (Italy)). Nov 1987. 29p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702991/JAW.

This paper deals with the solvability of the nonlinear operator equations in normed spaces $Lx=Gx+f$, where L is a linear map with possible nontrivial kernel. Applications are given to the existence of periodic solutions for the third order scalar differential equation $x'''+ax''+bx'+cx+g(t,x)=p(t)$, under various conditions on the interaction of g(t,x)/x with spectral configurations of a, b and c. (author). 48 refs.

42165 **(IC—87/374) Non-resonant oscillations for some third-order differential equations II.** Ezeilo, J.O.C.; Omari, P. (International Centre for Theoretical Physics, Trieste (Italy); Trieste Univ. (Italy). Dipt. di Scienze Matematiche). (International Centre for Theoretical Physics, Trieste (Italy)). Nov 1987. 25p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702994/JAW.

The existence of 2π-periodic solutions to the equation $x'''+ax''+g(t,x')+cx=p(t)$ is proved, under certain non-resonance conditions on the non-linear function g(t,y). Here a,c are constants, but the case where a,c are not necessarily constants is also discussed, subject to some rather special non-resonance conditions on g. The uniqueness of the solutions is also examined. (author). 12 refs.

42166 **(IC—87/381) Transfer matrix in 1D Schroedinger problems with constant and position-dependent mass.** Perez-Alvarez, R.; Rodriguez-Coppola, H. (International Centre for Theoretical Physics, Trieste (Italy); Havana Univ., La Habana (Cuba). Dept. of Theoretical Physics). (International Centre for Theoretical Physics, Trieste (Italy)). Oct 1987. 16p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702997/JAW.

We consider the transfer matrix method for obtaining properties of standard wells and barriers in one-dimensional Schroedinger problems with constant and position-dependent mass. We report the formulae for the energy levels of a well and the transmission coefficient of a barrier. We demonstrate the continuity between virtual bound states and bound states in a well of position-dependent mass and the relation between the zero energy gap states of a periodic potential problem with the corresponding energies of the non-periodic ones with transmission coefficient equal to one. The calculations were carried out for a wide class of potential profiles. (author). 30 refs, 2 figs.

42167 **(IC—87/392) Transfer matrix in the quasiclassical approximation with constant and position-dependent mass, resonant tunneling.** Perez-Alvarez, R.; Rodriguez-Coppola, H.; Lopez-Gondar, J.; Izquierdo, M.L. (International Centre for Theoretical Physics, Trieste (Italy); Havana Univ., La Habana (Cuba). Dept. of Theoretical Physics). (International Centre for Theoretical Physics, Trieste (Italy)). Nov 1987. 17p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703002/JAW.

We develop the quasiclassical approximation for the effective Hamiltonians describing nonhomogeneous systems and we deduce the wave function, the applicability conditions and the connection rules around the turning points. Based on the transfer matrix (TM) formalism we obtain expressions for the transmission coefficient of multiple barriers, the energy levels of multiple wells and the quasistationary levels of a well open by one, and by the two sides. The dispersion relation of a periodic potential profile with variable mass problem is also given. We discuss resonant tunneling for a system of multiple barriers. The transmission coefficient of such a barrier is maximum at energies close to the levels of the inner well when the end barriers are high enough and symmetric. (author). 20 refs, 1 fig.

42168 **(IC—87/394) Asymptotic functions of many variables and singular operations with Schwartz distributions.** Damyanov, B.P. (International Centre for Theoretical Physics, Trieste (Italy)). Nov 1987. 17p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703004/JAW.

A theory of the asymptotic functions for the case of many variables is presented. It is shown that the class F(R/sup N/) of these generalized functions is closed in respect to the linear algebraic and analytic operations, multiplication as well as a set of linear and polynomial changes of the variables. The existence in F(R/sup N/) of analogues (consistent with the linear operations) of the Schwartz distributions with point support is proved. In terms of these analogues, some formulae for singular products and changes of variables of the Dirac δ-function and its derivatives δ/sup (i)/(x), x is an element of R/sup N/, are given. (author). 14 refs.

42169 **(IC—87/408) General complex-analytic structures in uniform algebra spectra. A survey.** Tonev, T.V. (International Centre for Theoretical Physics, Trieste (Italy)). Dec 1987. 22p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703010/JAW.

The article is devoted to the development of the theory of complex analytic structure in uniform algebra spectra, more general than one-dimensional ones, to eliminate at the same time the limiting finiteness conditions from the existing classical theory. 47 refs.

42170 **(IC—87/412) Pauli fermions as components of N=2 supersymmetrical quantum mechanics.** Andrianov, A.A.; Ioffe, M.V. (International Centre for Theoretical Physics, Trieste (Italy); Leningrad State Univ. (USSR). Dept. of Theoretical Physics). (International Centre for Theoretical Physics, Trieste (Italy)). Dec 1987. 8p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88703013/JAW.

We consider the Pauli Hamiltonian for charged fermions in electromagnetic and scalar potentials as being a component of the N=2 supersymmetrical Hamiltonian. The admissible class of electromagnetic potentials is described. For a subclass of such potentials the fermion spectrum consists of pairs of equally splitted levels. The double degeneracy of levels (the sign of hidden supersymmetry) arises for holomorphic superpotentials. (author). 14 refs.

42171 **(IC—87/417) Note on completeness of the category of real functions.** Zaidi, S.M.A. (International Centre for Theoretical Physics, Trieste (Italy)). Dec 1987. 12p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703018/JAW.

In this article we construct a category zeta(R) whose objects are real functions with any domain in zeta (category of sets) and whose morphisms are the set functions in zeta which satisfy a certain condition. We study some properties of zeta(R) with the help of a functor K:zeta(R)->zeta and obtain that it is complete and cocomplete in the finite sense. The notation and basic concepts of category theory used in this article are all well known. 5 refs.

42172 **(IC—87/418) Conformal mappings of surfaces and Cauchy-Riemann inequalities.** Eschenburg, J.H.; Tribuzy, R. (Freiburg Univ. (Germany, F.R.). Mathematisches Inst.). (International Centre for Theoretical Physics, Trieste (Italy)). Dec 1987. 24p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703019/JAW.

H. Hopf has introduced the use of holomorphic quadratic forms to study surfaces with constant mean curvature in R/sup 3/. The same techniques have been used to study surfaces immersed in spaces forms, complex projective spaces and also to study harmonic maps. Following Hopf's ideas we consider holomorphic type forms, that is, forms whose zeroes behave like zeroes of holomorphic forms, to study surfaces such that the norm of the mean curvature vector or of its covariant derivative satisfies some inequality. We also apply the same techniques to study maps whose tension field satisfies similar property. (author). 17 refs.

42173 **(IC—87/423) Experiments of the EPR-type involving CP-violation do not allow faster-than-light communication between distant observers.** Ghirardi, G.C.; Grassi, R.; Weber, T.; Rimini, A. (International Centre for Theoretical Physics, Trieste (Italy); Trieste Univ. (Italy). Ist. di Fisica Teorica; Pavia Univ. (Italy). Ist. di Fisica Nucleare). (International Centre for Theoretical Physics, Trieste (Italy)). Nov 1987. 12p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703022/JAW.

The proof that faster-than-light communication is not permitted by quantum mechanics derived some years ago by three of us, is extended to cover the case of measurements which do not fit within the standard scheme based on sets of orthogonal projections. A detailed discussion of a recent proposal of superluminal transmission making resort to a CP-violating interaction is presented. It is shown that such a proposal cannot work. (author). 8 refs.

42174 **(IC—88/8) Automatic quadrature with conditionally activated extended Clenshaw-Curtis rules.** Adam, G.; Nobile, A. (International Centre for Theoretical Physics, Trieste (Italy)). Jan 1988. 26p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703029/JAW.

Quadrature rules of the extended Clenshaw-Curtis (ECC) type are derived for integrands with trigonometric or hyperbolic weight functions. The study puts into evidence the existence of a fully analytic solution, in terms of hypergeometric functions /sub 0/F/sub 1/. An important implementation problem, namely the possibility of conditional activation of the ECC, is evidenced and solved. As compared with the best available similar code (QUADPACK, by Piessens et al.), our resulting code is sensibly faster, requires a significantly smaller overhead, while yielding a fully reliable output. (author). 13 refs, 6 tabs.

42175 **(IC—88/18) Natural differential operators on vectorial fibers.** Ezin, J.P. (International Centre for Theoretical Physics, Trieste (Italy)). Jan 1988. 19p. (In French). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703037/JAW.

This paper is an expository talk which presents concepts involved in proving the following proposition. On a closed Riemannian 4-manifold M equipped with a conformal class γ with the positive Yamabe number μ/sub γ/, every Yang-Mills field R/sup nabla/ on an SU(2)-bundle over M is self-dual whenever 48$\int$/sub M/ chemical bondR/sub -//sup nabla/chemical bond/sup 2/<μ/sub γ/. (author). 20 refs.

42176 **(IC—88/22) Iterative approximation of the solution of a monotone operator equation in certain Banach spaces.** Chidume, C.E. (International Centre for Theoretical Physics, Trieste (Italy)). Jan 1988. 11p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703039/JAW.

Let X=L/sub p/ (or l/sub p/), p $\geq$ 2. The solution of the equation Ax=f, f is an element of X is approximated in X by an iteration process in each of the following two cases: (i) A is a bounded linear mapping of X into itself which is also bounded below; and, (ii) A is a nonlinear Lipschitz mapping of X into itself and satisfies < Ax-Ay, j(x-y) > $\geq$ m chemical bondx-ychemical bond/sup 2/, for some constant m > 0 and for all x, y in X, where j is the single-valued normalized duality mapping of X into X* (the dual space of X). A related result deals with the iterative approximation of the fixed point of a Lipschitz strictly pseudocontractive mapping in X. (author). 12 refs.

42177 **(IC—88/23) Iterative solution of a nonlinear operator equation.** Chidume, C.E. (International Centre for Theoretical Physics, Trieste (Italy)). Jan 1988. 10p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88703040/JAW.

Suppose X=L/sub p/, p $\geq$ 2, and K is a non-empty closed convex subset of X. Suppose T:K -> X is a monotonic Lipschitzian mapping with Lipschitz constant L $\geq$ 1 such that, for x in K and fixed f in X, the equation x+Tx=f has a solution in K. Define the sequence (x/sub n/)/sup ∞/n=0 by x/sub 0/ is an element of K, x/sub n+1/=x/sub n/+λr/sub n/, for n $\geq$ 1, where λ=((p-1)L/sup 2/)/sup -1/ and r/sub n/=f-x/sub n/-Tx/sub n/. Then, (x/sub n/)/sup ∞/n=0 converges strongly to a solution of x+Tx=f in K. Convergence is at least as fast as a geometric progression with ratio (1-λ)/sup 1/2/. A related result deals with convergence of the sequence (x/sub n/)/sup ∞/n=0 when T is monotone and locally Lipschitzian. (author). 19 refs.

42178 **(IC—88/24) Approximation of fixed points of Lipschitz pseudo-contractive mapping in Banach spaces.** Chidume, C.E. (International Centre for Theoretical Physics, Trieste (Italy)). Jan 1988. 12p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703041/JAW.

Let K be a subset of a real Banach space X. A mapping T:K -> X is called pseudo-contractive if the inequality chemical bondchemical bondx-ychemical bondchemical bond $\leq$ chemical bondchemical bond(1+r)(x-y)-r(Tx-Ty)chemical bondchemical bond holds for all x,y in K and r > 0. Fixed points of Lipschitz pseudocontractive maps are approximated under appropriate conditions, by an iteration process of the type introduced by W.R. Mann. This gives an affirmative answer to the problem stated by T.L. Hicks and J.R. Rubicek (J. Math. Anal. Appl. 59 (1977) 504). (author). 28 refs.

42179 **(IC—88/28) Strict topologies and (DF)-spaces.** Zafarani, J. (International Centre for Theoretical Physics, Trieste (Italy)). Feb 1988. 5p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88703044/JAW.

The topology β/sub rho/ has been introduced and studied on C/sub b/(X,E), the space of all bounded continuous E-valued functions. In this paper we give a necessary and sufficient condition

for the space C/sub b/(X,E) equipped with β/sub rho/ to be a (DF)-space, and as a corollary we obtain directly a result of Mendoza for the space C(X,E) equipped with tau/sub rho/ to be a (DF)-space. (author). 4 refs.

42180 **(IC—88/31) Asymptotic behaviour of quasi-autonomous dissipative systems in Hilbert spaces.** Djafari Rouhani, B. (International Centre for Theoretical Physics, Trieste (Italy)). Feb 1988. 17p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703045/JAW.

We study the asymptotic behaviour of the quasi-autonomous dissipative system: (du)/dt + Au such that f where A is a monotone operator in a Hilbert space H and f is an element of L/sup 1/ ((0, + ∞); H). (author). 28 refs.

42181 **(IC—88/35) Residual circuits in generalized monoidal transformations.** Glazebrook, J.F.; Verjovsky, A. (Rutgers Univ., New Brunswick, NJ (USA). Dept. of Mathematics). (International Centre for Theoretical Physics, Trieste (Italy)). Feb 1988. 14p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703046/JAW.

We describe a topological construction which can be used to compute characteristic classes of a sequence of generalized monoidal transformations via the characteristic ring of a principal G-bundle. The results described in this paper might be compared with those of Porteous to blow-up Chern classes. (author). 6 refs.

42182 **(IC—88/38) On a functional equation over Hilbert spaces.** Thaheem, A.B.; Mohammad, N. (International Centre for Theoretical Physics, Trieste (Italy)). Feb 1988. 6p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88703047/JAW.

In this note we answer a problem proposed by Watatani and show that if α, β are commuting unitary operators on a Hilbert space H satisfying the equation $\alpha+\alpha$/sup -1/=$\beta+\beta$/sup -1/, then H can be decomposed by a projection p on H such that $\alpha=\beta$ on pH and $\alpha=\beta$/sup -1/ on (1-p)H. We also prove a similar decomposition result for one-parameter groups of unitary operators on H. (author). 12 refs.

42183 **(IC—88/44) How to test the special theory of relativity on rotating earth.** Abolghasem, H.; Khadjehpoor, M.R.; Mansouri, R. (Sharif Univ. of Technology, Teheran (Iran)). (International Centre for Theoretical Physics, Trieste (Italy)). Feb 1988. 6p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88703048/JAW.

In the framework of a one parameter test theory of special relativity, the difference between Transport- and Einstein synchronization on the rotating earth is calculated. For the special theory of relativity this difference vanishes. Therefore, experiments in which these synchronization procedures are compared, test the special theory of relativity. (author). 8 refs.

42184 **(IC—88/45) Operations involving momentum variables in non-Hamiltonian evolution equations.** Benatti, F.; Ghirardi, G.C.; Rimini, A.; Weber, T. (International School of Advanced Studies, Trieste (Italy); International Centre for Theoretical Physics, Trieste (Italy); Pavia Univ. (Italy). Dipt. di Fisica Nucleare e Teorica; Trieste Univ. (Italy). Dipt. di Fisica Teorica). (International Centre for Theoretical Physics, Trieste (Italy)). Feb 1988. 37p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703166/JAW.

Non-Hamiltonian evolution equations have been recently considered for the description of various physical processes. Among this type of equations the class which has been more extensively studied is the one usually referred to as Quantum Dynamical Semigroup equations (QDS). In particular an equation of the QDS type has been considered as the basis for a model, called Quantum Mechanics with Spontaneous Localization (QMSL), which has been shown to exhibit some very interesting features allowing to overcome most of the conceptual difficulties of standard quantum theory, QMSL assumes a modification of the pure Schroedinger evolution by assuming the occurrence, at random times, of stochastic processes for the wave function corresponding formally to approximate position measurements. In this paper, we investigate the consequences of modifying and/or enlarging the class of the considered stochastic processes, by considering the spontaeous occurrence of approximate momentum and of simultaneous position and momentum measurements. It is shown that the considered changes in the elementary processes have unacceptable consequences. In particular they either lead to drastic modifications in the dynamics of microsystems or are completely useless from the point of view of the conceptual advantages that one was trying to get from QMSL. The present work supports therefore the idea that QMSL, as originally formulated, can be taken as the basic scheme for the generalizations which are still necessary in order to make it appropriate for the description of systems of identical particles and to meet relativistic requirements. (author). 14 refs.

42185 **(IC—88/46) On equivariant Lagrangians.** Konderak, J.J. (International Centre for Theoretical Physics, Trieste (Italy)). Mar 1988. 12p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703167/JAW.

Considered here is a functor which with each pair of Riemannian manifolds associates a first order Lagrangian defined on the space of jets of functions from one manifold to the other. With some additional assumptions motivated from the geometry of the manifolds, that factor is called a Riemannian Lagrangian. It is then shown that each Riemannian Lagrangian is induced by elementary symmetric functions and a real valued smooth function. (author). 6 refs.

42186 **(IC—88/52) Second class constraints and their elimination in the quantum theory.** Shiekh, A.Y. (International Centre for Theoretical Physics, Trieste (Italy)). Mar 1988. 11p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703049/JAW.

It is shown how second class constraints are inconsistent, even classically, and methods for their elimination are discussed in a quantum mechanical context. (author). 13 refs.

42187 **(IFVE-ONF—87-79) On estimating distributions with maximum entropy principle.** Zhigunov, V.P.; Kostkina, T.B.; Spiridonov, A.A. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1987. 20p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703190/JAW.

Submitted to the journal NIM.

A possibility to use the maximum entropy principle to estimate distributions by their measurements with the known resolution fucntions has been considered. The general analytical form of the distribution estimate has been obtained. Statistical properties of this estimate - the error matrix and bias - have been analyzed. The method is generalized for the case when a looked for distribution is known to be close to a certain known one. The proposed method is illustrated by a number of numerical experiments. Results are compared with those obtained by other methods. 18 refs.; 9 figs.

42188 (INIS-SU—45, pp 24-25) **Equation for the Green statistical function in Keldysh diagram technique for relaxation processes.** Tikhodeev, S.G. 1987. (In Russian). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88780096/JAW.

Kratkie Soobshcheniya po Fizike.; (No. 11).
In Plasma physics. Collection.

42189 **(INIS-SU—45) Plasma physics. Collection.** (AN SSSR, Moscow. Fizicheskij Inst.). 1987. 61p. (In Russian). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88780096/JAW.

Kratkie Soobshcheniya po Fizike.; (No. 11).
Individual papers have been indexed separately. (WRF)

42190 **(INIS-SU—53) Quantum mechanics of the diatomic substitutional impurity in a monoatomic hcp lattice.** Chishko, K.A. (AN Ukrainskoj SSR, Kharkov. Fiziko-Tekhnicheskij Inst. Nizkikh Temperatur). 1986. 16p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703068/JAW.

Preprint-62-86.

In the approximation of atom-atom central power-type potentials, a representation of the crystalline field of nearest neighbours in the vicinity of a static hcp lattice site is obtained and the crystalline potential for rotation of diatomic homo- and heteronuclear substitutional impurities is calculated. The Schroedinger equation is solved by numerical methods for the space rotator in the crystalline field of an hcp lattice; it yields the dependence of the spectrum of rotational states on the rotational barrier amplitude. The calculation used parameters corresponding to nitrogen and carbon monoxide in argon and krypton matrices. 22 refs.; 1 fig.; 2 tabs.

42191 (ITEF—93(1987)) Properties of invariant modelling and invariant glueing of vector fields. Petukhov, V.R. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1987. 6p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88703297/JAW.

Invariant modelling and invariant glueing of both continuous (rates and accelerations) and descrete vector fields, gradient and divergence cases are considered. The following appendices are discussed: vector fields in crystals, crystal disclinations, topological charges and their fields. 5 refs.

42192 (ITEF—119(1987)) New representations of thermodynamical functions for the Fermi gas. Blinnikov, S.I.; Rudzskij, M.A. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1987. 17p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703304/JAW.

The equation of state of an equilibrium ideal gas of fermions is expressed through integrals or series which are easily evaluated for relativistic density or temperature. The accuracy of these representations is numerically determined. 8 refs.; 4 figs.

42193 (ITEP—100(1987)) Quasiclassical deformation in KP hierarchy and Benney's long wave equations. Kolokol'tsov, V.N.; Lebedev, D.R. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1987. 25p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703319/JAW.

In the paper by means of the formal variant of Zakharov-Shabat "dressing" method various formulas are obtained for the generating functions of the conservation laws of Kadomtsev-Petvias hierarchy which turn into analogous formulas for Benney hierarchy in the quasiclassical limit. The generating fucntion of the conservation laws of Miura type is constructed for higher Benney equations and the simple proof of the related identities is given. 17 refs.

42194 (JINR-E—2-87-168) New analytically solvable models of relativistic point interactions. Gesztesy, F.; Seba, P. (Graz Univ. (Austria). Inst. fuer Theoretische Physik; Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1987. 12p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703343/JAW.

Submitted to the journal Lett. Math. Phys. .

Two new analytically solvable models of relativistic point interactions in one dimension (being natural extensions of the non-relativistic δ-resp, δ'-interaction) are considered. Their spectral properties in the case of finitely many point interactions as well as in the periodic case are fully analyzed. Moreover the spectrum is explicitely determined in the case of independent, identically distributed random coupling constants and the analog of the Saxon and Huther conjecture concerning gaps in the energy spectrum of such systems is derived. 43 refs.

42195 (JINR-E—4-87-743) Multistep adiabatic representation. Dubovik, V.M.; Markovskij, B.L.; Vinitskij, S.I. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1987. 10p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88703361/JAW.

Submitted to the journal J. Phys., A.

A step-by-step adiabatic approximation for the N-particle quantum mechanical problem is introduced in order to study the induced gauge field. The complex-vector-bundle formalism provides a natural framework for description of the multi-channel effective dynamics. 12 refs.

42196 (JINR-E—5-87-13) Scattering matrix and spectral shift function of the nuclear dissipative scattering theory. Neidhardt, H. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1987. 32p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703364/JAW.

Submitted to the journal J. Oper. Theory.

The paper is devoted to the problem of existence of the spectral shift function for a pair of contractions which differ by a nuclear operator, it is well-known that the usual spectral shift function for a pair of unitary operators does not allow an extension to this case in general and, moreover, the shift function cannot be obtained as a summable one. This fact yields for instance that the famous trace formula cannot be verified in this situation. In the paper the notion of the spectral shift function is generalized in an appropriate manner such that the shift is summable and satisfies a modified trace formula. Moreover, a modification of the Birman-Krein formula is established. All results are transformed to a pair of maximal dissipative operators whose resolvent difference belongs to the trace class. 23 refs.

42197 (JINR-E—5-87-94) Von Neuman representations on self-dual Hilbert W* moduli. Frank, M. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1987. 16p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703365/JAW.

Submitted to the journal Math. Nachrichten.

Von Neumann algebras M of bounded operators on self-dual Hilbert W* moduli H possessing a cyclic-separating element x-bar in H are considered. The close relation of them to certain real subspaces of H is established. Under the supposition that the underlying W*-algebra is commutative, a Tomita-Takesaki type theorem is stated. The natural cone in H arising from the pair (M, x-bar) is investigated and its properties are obtained. 9 refs.

42198 (JINR-E—5-87-95) One-parameter groups arising from real subspaces of self-dual Hilbert W* moduli. Frank, M. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1987. 20p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703366/JAW.

Submitted to the journal Math. Nachrichten.

The paper generalizes the result of M.A. Rieffel and A. van Daele for Hilbert C*-moduli over commutative W*-algebras. Some special real subspaces of such Hilbert W*-moduli and the related operators are investgated. Particularly, the relation is established between strongly continuous unitary one-parameter groups of operators arising from them and the generalized K.M.S. condition. All key definitions are formulated without any commutativity supposition for the underlying W*-algebra. The interpretation of these results is given for sets of continuous sections of "self-dual" locally trivial Hilbert bundles over compact spaces. 12 refs.

42199 (JINR-E—5-87-330) On the dissipative Lax-Phillips scattering theory. Neidhardt, H. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1987. 23p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703367/JAW.

Submitted to the journal J. Math. Anal. Appl. .

The paper is devoted to the characterization of all possible scattering matrices occurring in a dissipative Lax-Phillips scattering theory. The characterization is obtained in terms of an analytically unitary synthesis of a strongly measurable contraction-valued function which generalizes the notion of Darlingtom synthesis. 7 refs.

42200 **(JINR-E—5-87-710) Exact solutions to a time-dependent Schroedinger equation with self-consistent potential.** Dubrovin, B.A.; Malanyuk, T.G.; Krichever, I.M.; Makhankov, V.G. (Moskovskij Gosudarstvennyj Univ. (USSR); Moskovskij Ehnergeticheskij Inst. (USSR)). (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Computing Techniques and Automation). 1987. 46p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703368/JAW.

Submitted to the EhChAYa.

Description of integrable models associated with a time-dependent Schroedinger equation is given along with constructing their multisoliton formulae. Among such models there are the vector versions of NLS, Yajima-Okiawa model and others. In constructing exact solutions the communication relations are not used. The condensate boundary conditions are considered for noncompact models where the conventional technique of the inverse transform is not effective. The proposed approach is based on the algebro-geometrical theory of integrable systems and allows to construct all known by now exact solutions of such systems. The review contains a number of original results and is addressed to nonmathematicians. 31 refs.

42201 **(JINR-E—5-87-784) Threshold of KdV soliton production.** Kholmurodov, Kh.T.; Makhankov, V.G.; Pashaev, O.K. (Tadzhikskij Gosudarstvennyj Univ., Dushanbe (USSR)). (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Computing Techniques and Automation). 1987. 12p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703369/JAW.

Submitted to the journal Phys. Scripta.

Decay of the zero area pulses is investigated for the Kortweg-de Vries equation. By using a linear representation of the Kortweg-de Vries equation the problem is reduced to solution of a simple quantum-mechanical problem. The transcendent equation for eigenvalues is obtained and its numerical analysis is carried out. The existence region of the discrete energy levels, corresponding to a soliton lattice of the Kortweg-de Vries equation is found. The threshold existence of discrete energy level in the zero area potential is established. The numerical simulation results on the decay of zero area pulses are compared with the existence region which is predicted for the discrete energy levels. 7 refs.; 3 figs.; 3 tabs.

42202 **(JINR-R—2-87-136) Reflection of waves in nonlinear integrable systems.** Mel'nikov, V.K. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1987. 22p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703381/JAW.

Submitted to the journal J. Math. Phys. .

Solutions of the boomeron-type are found in two nonlinear integravle systems describing the interaction of a long wave with a short wave packet. These solutions follow from two-soliton solution if certain additional conditions are imposed on their parameters. The results are relevant to some problems of plasma physics, solid state physics, hydrodynamics, etc. 4 refs.

42203 **(JINR-R—2-87-137) Decay and fusion of waves on the x,y plane.** Mel'nikov, V.K. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1987. 18p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703382/JAW.

Submitted to the journal Phys. D.

In a nonlinear integrable system describing the interaction of a long wave with a short wave packet we have found exact solutions having the asymptotics of a solitary wave as t -> -∞ and decaying into several solitons, that move with different phase velocities, as t -> ∞. The obtained results are relevant to some problems of hydrodynamics, plasma physics, etc. 3 refs.

42204 **(JINR-R—2-87-301) WKB solutions of quasipotential equations in the momentum representation.** Kapshaj, V.N.; Konoplyannikov, V.F.; Starikov, V.N.; Skachkov, N.B. (Gomel'skij Gosudarstvennyj Univ. (Byelorussian SSR); Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1987. 14p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703387/JAW.

Quasipotential equations with local potentials in the Lobachevsky momentum space are studied. the integral equations for the wave functions are reduced to the Sturm-Liouville problem directly in the momentum space. The JWKB solution of this problem is found. In a chiral limit when the bound state mass tends to zero the correspondence between the JWKB and exact solutions is obtained. 11 refs.

42205 **(JINR-R—2-87-451) Mechanism of the Laudon down degeneration.** Davtyan, L.S.; Pogosyan, G.S.; Ter-Antonyan, V.M.; Sisakyan, A.N. (Erevanskij Gosudarstvennyj Univ. (USSR); Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1987. 3p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88703391/JAW.

Submitted to the journal J. Phys. A: Lett. Ed. .

The Laudon effect of double degeneration has been mathematically explained within the framework of theory of hidden symmetry of a one-dimensional hydrogen atom. In this note a more natural physical explanation of this surprising phenomenon is proposed. 8 refs.; 1 fig.

42206 **(JINR-R—2-87-454) Algebraization of elliptic Coulomb wave functions in the continuous spectrum.** Davtyan, L.S.; Pogosyan, G.S.; Ter-Antonyan, V.M.; Sisakyan, A.N. (Erevanskij Gosudarstvennyj Univ. (USSR)). (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1987. 6p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88703392/JAW.

Submitted to the journal Theor. Math. Phys. .

Trinomial recurrent relations specifying in the continuous spectrum decomposition of elliptical Coulomb wave functions by polar basis of two-dimensional hydrogen atoms are found. This algebraization is suitable for development of the perturbation theory when calculating elliptical corrections to the polar basis. 10 refs.

42207 **(JINR-R—2-87-494) Mathematical problems of description of the wave interaction on the x, y plane.** Mel'nikov, V.K. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1987. 18p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703393/JAW.

Submitted to the Organizing Committee on nonlinear differential equations, 28 Sep - 3 Oct 1987, Varna, NRB.

A system of nonlinear evolution equations describing the interaction of long wave with a short wave packet on the x,y plane is considered. Conditions are pointed out under which this system can be investigated by the inverse scattering method. This method was used to derive several types of solutions describing cancellation of waves, decay and fusion of waves, etc. This underlies two purely mathematical problems having important applications. The obtained results are relevant to the problem of hydrodynamics, plasma physics, etc. 6 refs.

42208 **(JINR-R—2-87-716) Areal models of relativistic space-finite objects.** Shavokhina, N.S. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1987. 6p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88703397/JAW.

Submitted to the Organizing Committee of the working conference /sup G/ravitation and Electromagnetism/sup ,/ Minsk, September 1987.

In the Poincare-Minkowski space-time, all possible objects are presented, spatial cross sections of which are geometrical fig-

ures of finite dimensions and which are mathematically modelled by means of the metric concepts of space-time, such as the length of a line, the area of surfaces of two and three dimensions, and the volume of the space-time itself. All the above-listed areal objects are described by the boundary-value problem for minimal surfaces of various dimensions. 18 refs.

42209 **(JINR-R—4-87-493) Effective potentials of the relativistic three-body problem with electromagnetic interaction in adiabatic approximation.** Bakalov, D.D.; Melezhik, V.S. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1987. 20p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703406/JAW.

Submitted to the journal Z. Phys., D.

The relativistic Hamiltonian for 3-spin particles with electromagnetic interaction has been represented in the form of a sum of terms with factorized dependence on spin, angular and spheroidal variable, and its matrix elements have been expressed in terms of the matrix elements of a small number of "basic" operators. The numerical values of the latter have been tabulated, thus allowing for the evaluation of the leading relativistic effects in any 3-body system (with unit particle charge) with and accuracy of ~ 0(1/2M), where 1/2M=(M/sub 1//sup -1/+M/sub 2//sup -1/)/2(M/sub 1//sup -1/+M/sub 3//sup -1/) is the small parameter of the adiabatic expansion (M/sub i/, i=1,2,3 being particle masses). 9 refs.; 2 tabs.

42210 **(JINR-R—11-87-749) Two-dimensional basis for three-body problem in hyperspherical coordinates.** Abrashkevich, A.G.; Vinitskij, S.I.; Kaschiev, M.S.; Puzynin, I.V. (Uzhgorodskij Gosudarstvennyj Univ. (Ukrainian SSR)). (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Computing Techniques and Automation). 1987. 15p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703418/JAW.

Submitted to the journal Sov. J. Nucl. Phys. .

Expansion over a two-dimensional basis is proposed for the wave function of a three-body problem in hyperspherical coordinates. As a result, the initial spectral problem in a three-dimensional space is reduced to a system of ordinary differential equations. Effective potentials of the system are constructed with the use of solutions of the spectral problem in a finite two-dimensional region with a pure discrete spectrum. The problem is solved numerically by the finite-element method and the method of subspace iteration. For the system Ps/sup -/=e/sup +/e/sup -/e/sup -/ series of point are found of quasi-intersections of potential curves pointing out strong nonadiabaticity of the system and possible existence of the group of dynamical symmetry. The energies of the ground and some highly excited states of that system are calculated within the 10/sup -4/ a.u. accuracy. 20 refs.; 8 figs.; 5 tabs.

42211 **(JINR-R—17-87-329) Coexistence of phases with different symmetry groups.** Yukalov, V.I. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1987. 7p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88703422/JAW.

Submitted to the Organizing Comittee of 16. International colloquium on group theory methods in physics, Varna, Bulgaria, June 1987.

A system is considered, in which several thermodynamic phases corresponding to different symmetry groups coexist. For such a heterophase system a representation of the algevra of local observables is realized, being defined as a functional integration over characteristic functions of submanifolds. Theorems are formulated letting to find average values of observable quantities. 10 refs.

42212 **(JINR-R—17-87-635) Effective pair potential in the lattice Fermi gas.** Litvin, A.A.; Priezzhev, V.B. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1987. 19p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703423/JAW.

Submitted to the journal J. Stat. Phys. .

An effective pair potential for a quantum mechanical lattice model of fermions interacting with two infinitely massive nuclei is derived exactly. A relation between the nucleus-nucleus potential and random walk generating functions is obtained by using the Trotter product formula. The detailed analysis of the pair potential for neighbour sites shows that there exist various possibilities to construct a nuclear sublattice kept by the effective interaction between nuclei. 9 refs.; 5 figs.; 3 tabs.

42213 **(KFKI—1987-74/B) Neutron stars with orbiting light.** Lukacs, B. (Hungarian Academy of Sciences, Budapest. Central Research Inst. for Physics). Nov 1987. 37p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703429/JAW.

There is a wide-spread belief in the literature of relativistic astrophysics concerning nonsingular final states of the stellar evolution: the external gravitational field of a physically nonsingular central symmetric body (e.g. a neutron star) is asymptotically empty and simple, i.e. there are no closed or trapped light-like causal geodesics. Present paper shows that this belief is false: some examples are presented for nonsingular bodies with various equations of state, around which there are closed light-like trajectories: 'orbiting light'. The reality of the used equations of state is discussed in detail. Present state of particle physics does not establish the existence of matter with such equations of state, but the hypothetical subquark level of matter may have such equation of state, thus 'subquark-stars' may exist with orbiting light around them. So the criterion of 'nonsingularity' must be further analyzed and accurately defined. (D.Gy.) 24 refs.; 5 figs.

42214 **(KFKI—1987-77/B) Causal boundary for stably causal space-times.** Racz, I. (Hungarian Academy of Sciences, Budapest. Central Research Inst. for Physics). Dec 1987. 28p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703431/JAW.

The usual boundary constructions for space-times often yield an unsatisfactory boundary set. This problem is reviewed and a new solution is proposed. An explicit identification rule is given on the set of the ideal points of the space-time. This construction leads to a satisfactory boundary point set structure for stably causal space-times. The topological properties of the resulting causal boundary construction are examined. For the stably causal space-times each causal curve has a unique endpoint on the boundary set according to the extended Alexandrov topology. The extension of the space-time through the boundary is discussed. To describe the singularities the defined boundary sets have to be separated into two disjoint sets. (D.Gy.) 8 refs.

42215 **(KU-HCOE-FL2-R—87-2) Simulated annealing with constant thermodynamic speed.** Salamon, P.; Nulton, J.; Robinson, J.; Ruppeiner, G.; Liao, L.; Pedersen, J. (San Diego State Univ., CA (USA). Dept. of Mathematical Sciences; San Diego City Coll., CA (USA). Dept. of Mathematics; Burroughs Corp., San Diego, CA (USA); University of South Florida, Sarasota (USA). Div. of Natural Sciences; San Diego Univ., CA (USA). Dept. of Mathematics). (Copenhagen Univ. (Denmark). H.C. Oersted Inst.). 1987. 15p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88754029/JAW.

Arguments are presented to the effect that the optimal annealing schedule for simulated annealing proceeds with constant thermodynamic speed, i.e., with $dT/dt = -(v\,T)/(\epsilon\sqrt{C})$, where T is the temperature, ϵ- is the relaxation time, C ist the heat capacity, t is the time, and v is the thermodynamic speed. Experimental results consistent with this conjecture are presented from simulated annealing on graph partitioning problems.

42216 **(NBI-TH—10/87) Hidden BRS invariance in classical mechanics.** Gozzi, E. (Niels Bohr Inst., Copenhagen (Denmark)). Nov 1986. 11p. (MPI-PAE/PTh—47/86). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88752705/JAW.

We give in this paper a path integral formulation of classical mechanics. We do so by writing down the associated classical-generating functional. This functional exhibits an unexpected BRS-like and antiBRS-like invariance. This invariance allows for a simple expression, in term of superfields, of this generating functional. Associated to the BRS and antiBRS charges there is also a ghost charge

whose conservation turns out to be nothing else than the well-known theorem of classical mechanics.

42217 (NORDITA—84/29-Prepr.) Stress: Concepts and applications. Nielsen, O.H.; Martin, R.M. (Nordisk Inst. for Teoretisk Atomfysik, Copenhagen (Denmark); Xerox Palo Alto Research Center, CA (USA)). 1984. 22p. (CONF-8407114—). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88752706/JAW.

From Antwerp Advanced Study Institute on electronic structure, dynamics and quantum structural properties of condensed matter; Priorij Corsendank, Belgium (16 Jul 1984).

The stress theorem determines the stress from the electronic ground state of any quantum system with arbitrary strains and atomic displacements. We derive this theorem in reciprocal space, within the local-density-functional approximation. The evaluation of stress, force and total energy permits, among other things, the determination of complete stress-strain relations including all microscopic internal strains. We describe results of ab-initio calculations for Si, Ge, and GaAs, giving the equilibrium lattice constant, all linear elastic constants c/sub ij/ and the internal strain parameter zeta.

42218 (UWThPh—1988-5) Holistic aspects of the Schroedinger equation. Pietschmann, H. (Vienna Univ. (Austria). Inst. fuer Theoretische Physik). 1988. 10p. (In German). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88703480/JAW.

The holistic (= non-local) aspects of the Schroedinger equation and the interpretation of quantum mechanics are emphasized. Further progress of quantum mechanics to quantum field theory, is discussed, with vacuum polarization and gauge theory as examples of holistic aspects. 10 refs. (qui).

42219 (UWThPh—1988-6) Space-time dynamical entropy of quantum systems. Hudetz, T. (Vienna Univ. (Austria). Inst. fuer Theoretische Physik). 1988. 12p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703481/JAW.

The definition of the dynamical entropy for single auto-morphisms of nuclear C/sup */-algebras is extended to groups of several commuting automorphisms. This entropy of a Z/sup ν/-action is shown to be nonzero only if all the corresponding Z/sup μ/-'subactions' ($0<\mu<\nu$) have infinite entropy. As a simple consequence, the space-time entropy of quantum lattice spin systems, and of one-dimensional continuous systems with 'physically reasonable' quasi-free states, vanishes. 22 refs.

42220 (UWThPh—1988-7) Reality problem in quantum mechanics. Flamm, D. (Vienna Univ. (Austria). Inst. fuer Theoretische Physik). 1988. 46p. (In German). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703482/JAW.

A series of 12 lectures on quantum mechanics and its interpretations: The more specific part begins with chapter 8: spin and polarization measurements; the Einstein-Podolski-Rosen paradoxon; Bell's inequations; interpretations of quantum theory; the role of the observer and the wave function of the world. 40 refs., 11 figs. (qui).

42221 Thermo field dynamics and para statistical mechanics. Biswas, S.N.; Das, A. (Dept. of Physics, Univ. of Delhi, Delhi (IN)). *Modern Physics Letters B;* **3**: No. 6, 549-560(May 1988).

Within the framework of thermo field dynamics, the authors derive the partition functions for a harmonic oscillator obeying parafermi and parabose statistics. The thermodynamic functions are studied for different limits of the order of the statistics and are shown to have the expected behaviour.

42222 On the asymptotic solution to a class of linear integral equations. Gautesen, A.K. (Ames Lab. and Dept. of Mathematics, Iowa State Univ., Ames, IA (US)). *SIAM Journal on Applied Mathemadics;* **48**: No. 2, 294-306(Apr 1988).

The authors consider Fredholm integral equations of the first kind whose kernels are a function of the difference between two points times a large parameter. Conditions on the kernel are stated in terms of a function corresponding to a Wiener-Hopf factorization of the Fourier transform of the kernel. They give the complete asymptotic expansions of the solution to the integral equations. As applications of the author's results, the author considers the steady-state, acoustical scattering of a plane wave by both a hard strip and a soft strip. The author's results are uniform with respect to the direction of incidence.

42223 (N—88-19172) Estimates of Green tensors for certain boundary value problems. Solonnikov, V. Translated from *Doklady Akademii Nauk SSSR ;* **130**: No. 5, 988-991(Feb 1988). 12p. (NASA-TT—20203; NAS—1.77:20203). NTIS, PC A03/MF A01.

Consider the first boundary value problem for a stationary Navier-Stokes system in a bounded three-dimensional region Omega with the boundary S: delta v = grad p+f, div v=0, v/s=0. Odqvist (1930) developed the potential theory and formulated the Green tensor for the above problem. The basic singular solution used by Odqvist to express the Green tensor is given. A theorem generalizing his results is presented along with four associated theorems. A specific problem associated with the study of the differential properties of the solution of stationary problems of magnetohydrodynamics is examined.

42224 Chaotic universe dynamics using a Fokker-Planck equation. Coule, D.H.; Olynyk, K.O. (Fermi National Accelerator Lab., P.O. Box 500, Batavia, IL 60510 (US)). *Modern Physics Letters A;* **2**: No. 11, 811-818(Nov 1987).

A Fokker-Planck equation that accounts for fluctuations in field and its conjugate momentum is solved numerically for the case of a λphi/sup 4/ potential. Although the amount of inflation agrees closely with that expected classically, in certain cases (large initial fields or large dispersions) the "slow rolling" approximation appears invalid. In such cases inflation would stop prematurely before possibly restarting.

42225 Quasisteady-state regime in transient stimulated Raman scattering. Ackerhalt, J.R.; Kurnit, N.A. (Los Alamos National Lab., Los Alamos, NM 87545 (US)). pp 140 of XV international conference on quantum electronics (Digest of technical papers). Washington, DC; Optical Society of America (1987). (CONF-870488—).

From 15. international conference on quantum electronics; Baltimore, MD, USA (27 Apr 1987).

Technical Paper THGG 1.

The question of the cumulative effect of multiple pulses on the Raman threshold for a pulse train has recently attracted some experimental attention. Although this problem can be modeled in a straightforward manner by integrating the transient equations for Raman scattering, the temporal resolution required to view the development of the individual pulses in the case of short pulses compared to the interpulse period may be prohibitive if the conversion reaches steady state only after many pulses. By making a physical argument as to the meaning of the quasisteady-state regime in transient stimulated Raman scattering, the authors are able to develop a method for easily calculating the pump-Stokes conversion by examining only a single pulse in a train which has reached equilibrium.

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REFER ALSO TO CITATION(S) 40614

42226 (DOE/ER—0365) Advanced fusion concepts project summaries, FY 1988. (USDOE Office of Energy Research, Washington, DC. Applied Plasma Physics Div.). Apr 1988. 43p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88011770/JAW.

This report summarizes all the projects supported by the Advanced Fusion Concepts Branch of the Applied Plasma Physics Division of the Office of Fusion Energy, US Department of Energy. Each project summary was written by the respective principal investigator using the format: title, principal investigators, funding levels, purpose, approach, progress, plans, milestones, graduate students, graduates, other professional staff, and recent publications.

This report is organized into three sections: Section one contains five summaries describing work in the reversed-field pinch program being performed by a diversified group of contractors, these include a national laboratory, a private company, and several universities. Section two contains eight summaries of work from the compact toroid area which encompasses field-reversed configurations, spheromaks, and heating and formation experiments. Section three contains summaries from two other programs, a density Z-pinch experiment and high-beta Q machine experiment. The intent of this collection of project summaries is to help the contractors of the Advanced Fusion Concepts Branch understand their relationship with the rest of the branch's activities. It is also meant to provide background to those outside the program by showing the range of activities of interest of the Advanced Fusion Concepts Branch.

42227 (EP-GILM-X-RA—1985) Greco Laser-matter interaction. (Ecole Polytechnique, 91 - Palaiseau (France)). 1986. 37p. (In French). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88752433/JAW.

Research program in 1985 at GRECO ILM (Group of Coordinated Research: Interaction Laser Matter) continued with its principal direction in fundamental physics of laser inertial confinement; also researches on X-ray lasers hare been undergone and new high power laser application fields with particle acceleration, material processing and X-ray sources. A six beam laser was operated. Wavelength effects were studied. Atomic physics was deeply stressed as dense medium diagnostics from multicharged ions. Research development in ultra-dense medium was also important X-ray laser research gave outstanding results. New research fields were developed this year: laser acceleration of particles by wave beating or Raman instability; dense laser produced plasma use as X-ray source; material processing by laser shocks.

42228 (EP-GILM-X-RA—1986) Progress report 1986. Laser-matter interaction Greco. (Ecole Polytechnique, 91 - Palaiseau (France)). 1987. 39p. (In French). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88752431/JAW.

Basic researches are based on laser-matter interaction, generation and study of dense and hot plasmas. The main aim is inertial fusion by laser; many researches are also engaged in other ways, basic ones such as X-ray laser and laser acceleration of particles, or applied ones such as X-ray sources or laser processing of materials.

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REFER ALSO TO CITATION(S) 41753, 41754, 42067, 42068, 42362, 42382, 42383, 42391, 42433, 42442, 42445, 42451, 42496

42229 (ANSTO/E—667) Analysis of magnetic field data from Rotamak VI. Watterson, P.A. (Australian Nuclear Science and Technology Organisation, Lucas Heights). Nov 1987. 24p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703093/JAW.

Magnetic field data from an array of points within the Rotamak VI at the Flinders University of South Australia are analysed using a new algorithm to integrate the experimentally measured gradient of a function of two variables. Evaluation of the poloidal flux function, using both components of the magnetic field, reveals two closed flux regions, one inside and one outside the radius of the rotating magnetic field (RMF) coils. The smoothed toroidal current density features a small region of reversed current outside the RMF coils. Plasma pressure is evaluated assuming pressure balance.

42230 (ANSTO/E—672) Rotamak equilibrium calculations using the PEST code. Watterson, P.A. (Australian Nuclear Science and Technology Organisation, Lucas Heights). Dec 1987. 18p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703096/JAW.

This report describes the use of the equilibrium part of the Princeton equilibrium and stability code PEST to model rotamak equilibria with an applied toroidal magnetic field. An overview of the code is provided, together with a list of required input data. The simulation of a range of equilibria measured in the ANSTO rotamak shows that the rotamak approximately satisfies magnetohydrodynamic equilibrium. Of particular interest is the presence of large diamagnetic poloidal current about the magnetic axis which produces a peak in the plasma pressure on the magnetic axis. For a low toroidal field, however, poloidal current of opposite direction is simultaneously driven on flux surfaces distant from the magnetic axis, producing paramagnetism.

42231 (CEA-CONF—9184) Broadband microwave reflectometer for Tore Supra. Millot, P.; Simonet, F. (Association Euratom-CEA, Centre d'Etudes Nucleaires de Cadarache, 13 - Saint-Paul-lez-Durance (France). Dept. de Recherches sur la Fusion Controlee). 1987. 4p. (CONF-870629—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88753889/JAW.

From 14. European conference on controlled fusion and plasma physics; Madrid, Spain (22 Jun 1987).

42232 (CEA-CONF—9186) Ece diagnostic on Tore Supra. Laurent, L.; Rodriguez, L.; Talvard, M. (Association Euratom-CEA, Centre d'Etudes Nucleaires de Cadarache, 13 - Saint-Paul-lez-Durance (France). Dept. de Recherches sur la Fusion Controlee). 1987. 4p. (CONF-870629—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88753890/JAW.

From 14. European conference on controlled fusion and plasma physics; Madrid, Spain (22 Jun 1987).

A quasi optical electron cyclotron emission diagnostic (12 Fabry-Perot and 3 Michelson interferometers) is being designed with the aim of giving measurements both in thermal and non thermal pulses.

42233 (CEA-CONF—9189) Non linear microtearing modes. Garbet, X.; Mourgues, F.; Samain, A. (Association Euratom-CEA, Centre d'Etudes Nucleaires de Cadarache, 13 - Saint-Paul-lez-Durance (France). Dept. de Recherches sur la Fusion Controlee). 1987. 4p. (CONF-870629—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88753893/JAW.

From 14. European conference on controlled fusion and plasma physics; Madrid, Spain (22 Jun 1987).

Among the various instabilities which could explain the anomalous electron heat transport observed in tokamaks during additional heating, a microtearing turbulence is a reasonable candidate since it affects directly the magnetic topology. This turbulence may be described in a proper frame rotating around the majors axis by a static potential vector. In strong non linear regimes, the flow of electrons along the stochastic field lines induces a current. The point is to know whether this current can sustain the turbulence. The mechanisms of this self-consistency, involving the combined effects of the thermal diamagnetism and of the electric drift are presented here.

42234 (CEA-CONF—9190) Charge exchange measurements with a doping neutral beam for Tore Supra. Fois, M.; Hoang, G.T.; Hutter, T. (Association Euratom-CEA, Centre d'Etudes Nucleaires de Cadarache, 13 - Saint-Paul-lez-Durance (France). Dept. de Recherches sur la Fusion Controlee). 1987. 4p. (CONF-870629—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88753894/JAW.

From 14. European conference on controlled fusion and plasma physics; Madrid, Spain (22 Jun 1987).

42235 (CEA-CONF—9192) Current rise assisted by lower hybrid waves on Petula-B. Houtte, D. Van; Parlange, F.; Briffod, G. (Association Euratom-CEA, Centre d'Etudes Nucleaires de Cadarache, 13 - Saint-Paul-lez-Durance (France). Dept. de Recherches sur la Fusion Controlee; CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France)). 1987. 4p. (CONF-870629—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88753896/JAW.

From 14. European conference on controlled fusion and plasma physics; Madrid, Spain (22 Jun 1987).

On the basis of the experimental results on Lower Hybrid Current Drive studies, it appears that the best efficiency of this non-inductive method is obtained in Tokamak discharges operating at low density and with a parallel DC electric field. These conditions are fulfilled when both lower hybrid waves and ohmic heating transformer are used to ramp-up the plasma current. In this paper, we present the results of such a scenario which has been carried out on Petula-B (R = 0.72 m, a = 0.17 m) by means of 1.3 GHz or 3.7 GHz RF system. For the purpose of these studies, plasma current or loop voltage are successively feedback controlled.

42236 **(CEA-CONF—9301) Numerical study of ion thermal gradient driven modes.** Garbet, X.; Laurent, L.; Mourgues, F.; Samain, A. (Association Euratom-CEA, Centre d'Etudes Nucleaires de Cadarache, 13 - Saint-Paul-lez-Durance (France). Dept. de Recherches sur la Fusion Controlee). 1987. 8p. (CONF-8708235—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88753916/JAW.

From International school of plasma physics; Varenna, Italy (24 Aug 1987).

Anomalous ion thermal confinement has been observed in tokamaks (1). The ion temperature gradient driven modes could provide a possible explanation of this fact. The goal of this paper is to examine the stability of such modes by a linear, analytical and numerical study. The value of the threshold parameter and the radial profiles of the modes are computed. The effects of the particles vertical drift due to the field curvature are discussed.

42237 **(CEA-CONF—9302) Bifurcation approach for ballooning and tearing instabilities in a toroidal plasma.** Maschke, E.K.; Morros Tosas, J. (Association Euratom-CEA, Centre d'Etudes Nucleaires de Cadarache, 13 - Saint-Paul-lez-Durance (France). Dept. de Recherches sur la Fusion Controlee). 1987. 8p. (CONF-8708235—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88753917/JAW.

From International school of plasma physics; Varenna, Italy (24 Aug 1987).

An exact representation of MHD in terms of stream functions and potentials is constructed in such a way that, instead of the velocity V, the product V x Bo is expressed by stream functions, where Bo is a reference magnetic field. From this, we derive a set of reduced equations which keep the distinction between paralled and toroidal motion. This representation is suited for the bifurcation theory of MHD instabilities. To illustrate this, we construct a class of analytical equilibria and we study its linear MHD stability in order to formulate the problem of the bifurcation of time-asymptotic solutions of the non linear MHD equations for a tearing and ballooning unstable toroidal plasma.

42238 **(CEA-CONF—9328) Spectroscopic diagnostics of tokamaks.** De Michelis, C. (Association Euratom-CEA, Centre d'Etudes Nucleaires de Cadarache, 13 - Saint-Paul-lez-Durance (France). Dept. de Recherches sur la Fusion Controlee). 1987. 10p. (CONF-8709143—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88753935/JAW.

From International colloquium on UV and X-ray spectroscopy; Beaulieu-Sur-Mer, France (9 Sep 1987).

Impurities being an important concern in tokamaks, spectroscopy plays a key role in their understanding. Techniques for the evaluation of concentrations, power losses and transport properties are surveyed, and a few developments are outlined.

42239 **(CEA-CONF—9329) Soft X-ray spectroscopy on the TFR Tokamak.** Schwob, J.L.; Breton, C.; De Michelis, C.; Hecq, W. (Association Euratom-CEA, Centre d'Etudes Nucleaires de Cadarache, 13 - Saint-Paul-lez-Durance (France). Dept. de Recherches sur la Fusion Controlee). 1987. 4p. (CONF-8709143—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88753936/JAW.

From International colloquium on UV and X-ray spectroscopy; Beaulieu-Sur-Mer, France (9 Sep 1987).

42240 **(CONF-880163—1) Long time impurity confinement as a precursor to disruptions.** Isler, R.C.; Rowan, W.L. (Oak Ridge National Lab., TN (USA); Texas Univ., Austin (USA). Fusion Research Center). 1988. Contract AC05-84OR21400. 19p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88006779/JAW.

From Meeting on density limits and disruptions; Abingdon, UK (26 Jan 1988).

The confinement time of laser-ablated test impurities in tokamaks lengthens considerably as operation approaches the density-limit boundary. Observations on the TEXT takamak indicate that a sharp change in the balance of diffusion and inward convection mechanisms governing impurity transport, at least in the interior of plasmas, occurs as a precursor of both partial and major disruptions in Ohmically heated discharges. Similar phenomena have been observed on other tokamaks, albeit with certain chartacteristics peculiar to each individual machine. These transitions can induce partial disruptions through impurity accumulation. Further study is required to ascertain whether they are a contributing factor major disruptions. Corresponding changes in the transport of the working gas ions have also been documented in TEXT. 11 refs., 9 figs.

42241 **(CONF-880364—11) ECE [electron cyclotron emission] diagnostic for ATF [Advanced Toroidal Facility].** Bell, G.L.; Gandy, R.F.; Wilgen, J.B.; Rasmussen, D.A. (Auburn Univ., AL (USA); Oak Ridge National Lab., TN (USA)). 1988. Contract AC05-84OR21400. 6p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE88007465/JAW.

From 7. topical conference on high temperature plasma diagnostics; Napa, CA, USA (13 Mar 1988).

Electron cyclotron emission (ECE) from the Advanced Toroidal Facility (ATF) torsatron will allow measurement of plasma electron temperature. For low field operation (.95T) the second harmonic is cutoff at a relatively low density; therefore, 3rd harmonic emission from 67-84 GHz is used to yield central electron temperatures. At high field operation (1.9T) 2nd harmonic emission from 82-114 GHz is optically thick and can provide T/sub e/(r) information. A vertical view of the saddle point geometry of the ATF mod B spatial contours provides a line of sight along which the B contours are symmetric with respect to flux surfaces. A single horn-lens viewing beam system with a vertical view is designed to cover the entire 67-114 GHz range, providing a spot size on the order of 6 cm. Radiation will be delivered to one of three waveguide mixers by C-band waveguide. Each of the three mixers covers a 16 GHz segment of the emission spectrum, downconverting it to the 2-18 GHz intermediate frequency band where it is processed by a 16-channel array of bandpass filters, providing 1 GHz frequency resolution.

42242 **(DOE/ER/53227—123) Magnetic and material limiter discharges in Tokapole II.** Moyer, R.A. (Wisconsin Univ., Madison (USA). Plasma Physics Research). 1988. Contract FG02-86ER53227. 168p. NTIS, PC A08/MF A01;1; GPO Dep. Order Number DE88011867/JAW.

Disruptive instabilities have been studied in Tokapole II, a small poloidal divertor tokamak, in magnetic and material limiter configurations. In the magnetic limiter configuration, the divertor separatrix defines the tokamak current channel boundary. Limiters or neutralizer plates are not used to remove plasma in the scrape-off region. The relatively hot, dense plasma in the scrape-off region carries 5--20% of the current. In the material limiter configuration, limiter plates are inserted to the separatrix to remove plasma and current in the scrape-off region. The plates vary the tokamak current channel boundary condition in a controlled manner, and provide a benchmark for comparison with other tokamaks. Internal and external disruptions have been studied, and several unique features in the magnetic limiter configuration have been identified. The magnitic limiter configuration enables routine passing of the stability barriers at q(a) = 2 and q(a) = 1, where q(a) is the the edge safety factor, without a close fitting wall, external windings, or detailed profile control techniques. Passing the q(a) = 1 barrier permits operation in the q < 1 regime where total reconnection of the sawtooth does not occur. Discharges with q < 1 are also obtained in the material limiter configuration, suggesting that partial reconnection is characteristic of the sawteeth, and not the magnetic

limiter configuration. The magnetic limiter configuration suppresses current termination in a major disruption. Current termination occurs in material limiter discharges due to enhanced interaction with the inboard limiter following the post-disruptive shift in major radius.

42243 (DOE/ER/53242—1) Experiments on linear high beta helical axis stellarators to study simulated toroidal effects and Alfven-wave heating: [Annual] progress report No. 1, February 16, 1987-November 15, 1987. Ribe, F.L. (Washington Univ., Seattle (USA)). 1987. Contract FG06-87ER53242. 108p. NTIS, PC A06/MF A01; 1; GPO Dep. Order Number DE88012985/JAW.

This paper discusses experiments on linear high beta helical axis stellarators. Experiments considered are: formation of linear high beta heliac plasma configurations; Alfven wave heating in a straight tube and in a linear high beat stellarator; shifted hardcore heliac studies; a system for measuring the timing of high-current switches in a pulsed high voltage fusion experiment; HBQM general refurbishment; and proposed experiment on excitation of the m = 1 tilt mode in field-reversed configurations. (LSP)

42244 (ENEA-RT-FUS—87-22) Contributions to the International school of Plasma Physics. Varenna, 24-28 August 1987. Romanelli, F. (ENEA, Rome (Italy)). 1987. 34p. (CONF-8708235—). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88701801/JAW.

From International school of plasma physics; Varenna, Italy (24 Aug 1987).

Three papers are reported concerning plasma physics. They are particulary referred to studies and experiences on this field carried out in the ENEA laboratories in Frascati (Italy).

42245 (EUR-CEA-FC—1334) Numerical modelisation of RF waves in the ion cyclotron range of frequency for Tokamak plasmas. Edery, D.; Picq, H.; Samain, A.; Gambier, D.J. (Association Euratom-CEA, Centre d'Etudes Nucleaires de Cadarache, 13 - Saint-Paul-lez-Durance (France). Dept. de Recherches sur la Fusion Controlee). Nov 1987. 43p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88753962/JAW.

The purpose of this paper is to present the numerical code ALCYON developed to compute the RF field structure in the ion cyclotron range of frequencies. The code handles fundamental and second harmonic heating while the mode conversion onto modes of decreasing wavelength is simulated by a selective power absorption on slow waves when their wavelength reaches the mesh size.

42246 (EUR-CEA-FC—1335) Current sustainment by synchrotron radiation in a tokamak device. Fidone, I.; Granata, G.; Johner, J. (Association Euratom-CEA, Centre d'Etudes Nucleaires de Cadarache, 13 - Saint-Paul-lez-Durance (France). Dept. de Recherches sur la Fusion Controlee). Jan 1988. 26p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88754055/JAW.

Current drive using anisotropic synchroton radiation in a tokamak device is considered. A relativistic formulation of the current drive efficiency which includes both momentum transfer and asymmetric resistivity is presented. The explicit computation of the current drive efficiency is performed for a Maxwellian plasma using Trubnikov's theory of radiation. The effect of the various synchrotron harmonics on the total generated current is examined and it is shown that most of the contribution comes from a few harmonics near n = ω/ω/sub c/ >> 1 for which the corresponding resonant velocities are in the same direction. The general properties of the synchrotron radiation and its capability to generate current in a reactor are also briefly discussed.

42247 (EUR-CEA-FC—1336) Specific microfluctuations associated with sawtooth relaxation in tokamak plasmas. Andreoletti, J.; Gervais, F.; Olivain, J.; Quemeneur, A.; Truc, A.; Gresillon, D. (Association Euratom-CEA Centre d'Etudes Nucleaires de Cadarache, 13 - Saint-Paul-lez-Durance (France). Dept. de Recherches sur la Fusion Controlee; Ecole Polytechnique, 91 - Palaiseau (France)). (Association Euratom-CEA, Centre d'Etudes Nucleaires de Cadarache, 13 - Saint-Paul-lez-Durance (France). Dept. de Recherches sur la Fusion Controlee). Feb 1988. 14p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88754056/JAW.

We observe in the TFR tokamak bursts of density fluctuations localized in space and time, synchronously with the sawtooth disruptions of the plasma. The CO/sub 2/ laser scattering experiment is briefly described together with the soft X ray diagnostic installed on TFR. The temporal evolution of the specific turbulence associated to the crash of the sawtooth is analysed. Dispersive properties (frequency, wave number) and spatial localization and amplitude data of these fluctuations are studied. The possible importance of these observations for interpreting the internal disruption is outlined.

42248 (EUR-CEA-FC—1337) Representation of toroidal MHD in terms of stream functions and potentials. Maschke, E.K.; Morros Tosas, J. (Association Euratom-CEA, Centre d'Etudes Nucleaires de Cadarache, 13 - Saint-Paul-lez-Durance (France). Dept. de Recherches sur la Fusion Controlee). Mar 1988. 47p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88754205/JAW.

An exact representation of toroidal magneto-hydrodynamics is proposed, in which the electromagnetic and the velocity fields are represented in terms of stream functions and potentials, without assuming any spatial symmetries. Two important features of this representation are the use of a time-independent but otherwise arbitrary reference field B/sub O/, and the fact that the vector product of the velocity V with B/sub 0/, and not V itself, is represented in terms of stream functions. In this way the equations take a form, which allows relatively easy physical interpretation and is well suited for deriving reduced MHD equations for particular stability problems.

42249 (IAE—4423/7) Determination of plasma boundaries in the experiments with compact torus. Goloviznin, V.M.; Romanovskij, V.I.; Semenov, V.N.; Chudanov, V.V. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1987. 8p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88703137/JAW.

A problem of determination of the plasma boundary profile has appeared in experiments with a compact torus. A method for solving the inverse problem providing for appreciable specification of a separatrix shape, as compared to the earlier methods, is proposed. According to the measured distribution of external magnetic field along the discharge tube and magnetic flux through the torus the separatrix shape, separating closed and opened, is calculated. Different approximations are studied. 4 refs.; 5 figs.

42250 (IFUSP-P—654) Resonant helical fields in TBR-1. Caldas, I.L.; Bender, O.W.; Fernandes, A.S.; Heller, M.V.; Kucinski, M.Y.; Nascimento, I.C. do; Tan, I.H.; Vannucci, A. (Sao Paulo Univ. (Brazil). Inst. de Fisica). Aug 1987. 12p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703173/JAW.

The main characteristics of Mirnov oscillations, sawtooth oscillations and disruptions on the small brazilian tokamak TBR-1 are presented. The alteration of these characteristics caused by helical fields created by external resonant helical windings are also reported. Helical winding current thresholds for the destruction of the magnetic surfaces in TBR-1 caused by the interaction of different resonant fields are estimated. The radial dependence of the perturbations and the change in the shear over the island widths are taken into account. The toroidal corrections are discussed and the exact solution of the Laplaces's equation for the magnetic scalar potential due to toroidal helical current is presented.

42251 **(IFUSP-P—656) TBR-1 (Brazilian Tokamak) - Recent Results.** Fagundes, A.N.; Cruz Junior, D.F. da; Galvao, R.M.O.; Elizondo, J.I.; Nascimento, I.C. do; Sa, W.P. de; Sanada, E.K.; Silva, R.P.; Tuszel, A.G.; Vannucci, A. (Sao Paulo Univ. (Brazil). Inst. de Fisica). Aug 1987. 12p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703174/JAW.

The TBR-1 is a small Tokamak installed at the Physics Institute of the University of Sao Paulo. The machine was designed in 1977 and begun to be used in plasma scientific research in early 1980. its main characteristics are: Major radius, 0,30m; Minor radius (limiter), 0,08m; Toroidal field, 5 KG; Plasma current, 10KA (typical); Current duration, 6 ms (typical). In this paper we report the results of recent experimental research done in the TBR-1.

42252 **(INIS-BR—1113) Effect of impurities in the electrothermic instability.** Azevedo, M.T. de. (Universidade Federal Fluminense, Niteroi (Brazil). Inst. de Fisica). Apr 1982. 118p. (In Portuguese). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88703214/JAW.

It is proposed a model for a "impure" plasma based on the homogenous hydrogen plasma used in the theory formulated by Tomimura and Haines to explain the increasing of instable electrothermal modes with wave vector perpendicular to the applyed magnetic field. The impurities are implicity introduced in the transport coeficients of the model of two fluids through the effective charge number Z/sub eff/ as suggested by Duechs et al., Furth etc... The results obtained are: (i) the greatest increasing ratio for the absolute mode (non-convective) decreases with the increasing of Z/sub eff/ going to zero for a given value of these parameter which is denominated Z/sub crit/; (ii) the wavelenght associated with that greatest ratio of increasing decreases with the increasing of Z /sub eff/; (iii) Z/sub crit/ x T/sub eo//T/sub io/ curves, where T /sub eo/ and T/sub io/ are the electronic and ionic temperatures of equilibri um show that, for each value of T/sub eo/ (used as a parameter) there is a limiting value Z/sub crit/ from which the plasma is stable, independently of the temperature ratio. The correlation of these results with that of a difuse pinch model, which shows the tendency in assume in the stationary state a filamental current structure is inconclusive with respect to the Z/sub eff/ dependence. (M.W.O.).

42253 **(INIS-BR—1119) Relativistic nonlinear waves of cyclotron in electron and electron-ion plasmas.** Bruno, R. (Universidade Federal Fluminense, Niteroi (Brazil). Inst. de Fisica). Dec 1981. 78p. (In Portuguese). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88703220/JAW.

Dispersion relations for electron-cyclotron and ion-cyclotron waves are examined in two models of plasmas, the first propagating in fluent electronic plasmas ("streaming") as well as in fluent electron-ionic plasmas, and the last in fluent electron-ionic plasmas. The identification of the propagation modes is realized with the aid of a special technique of polinomial expantion of the dispersion relation in the limit of large frequencies and short wavelenghts. The analisys so developed on these dispersion relations for fluent plasmas show that: (i) the wave amplitudes are frequency dependent; (ii) the "resonances" frequencies of the respective estationary plasmas must be re-examined with the relations between wave amplitudes and the propagation frequencies near these frequencies; (iii) the electric field amplitudes for the non-linear waves of electron-cyclotron and ion-cyclotron go to zero in the limits of the respective cyclotron frequencies in both fluent plasma models. (M.W.O.).

42254 **(INIS-mf—11257) Alfven wave spectrum of analytic high-beta tokamak equilibria.** Kleibergen, R. (Rijksuniversiteit Utrecht (Netherlands)). 9 Nov 1987. 133p. NTIS (US Sales Only), PC A07/MF A01. Order Number DE88703268/JAW.

Contains summary in Dutch.

This thesis addresses a number of problems regarding the equilibrium and stability of a tokamak plasma under fusion conditions. To get insight into the geometric effects on the behaviour of the most prominent global modes, a spectral study was carried out on a class of analytic, noncircular plasma equilibria. Parallel to this work, extending a previous high-beta energy principle a variational principle is developed for the numerical determination of the Alfven spectrum of a high-beta tokamak with arbitrary cross-section. Based on the Lagrangian formalism, representations were derived for the potential and kinetic energy in terms of arbitrary, non-orthogonal flux coordinates, which can be readily implemented in a numerical programme. The method is then tested by using the analytic equilibrium as input. 85 refs.; 32 figs.; 2 tabs.

42255 **(INIS-SU—5/A, pp 41-46) Theory of radiative attenuation of electromagnetic waves in relativistic magnetoactive plasma in hot hydrodynamics approximation.** Bogolyubov, N.N.; Polyakov, P.A.; Tasev, M.A. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1987. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88780078/JAW. (JINR-N—3(23)-87).

In JINR rapid communications. Collection.

Two-fluid theory of hydrodynamics for relativistic plasma is developed taking into account radiative moderation of charged particles, where relativistic Maxwell velocity distribution (Juttner-Synge distribution) is assumed. The radiative attenuation decrements for the Alfven cyclotron and electromagnetic waves are found. 9 refs.

42256 **(IPP—5/18) Algorithm for the resolution of conduction-convection boundary layers.** Zanino, R.; Lackner, K.; Schneider, W. (Max-Planck-Institut fuer Plasmaphysik, Garching (Germany, F.R.)). Feb 1988. 41p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88753819/JAW.

A finite difference time-dependent algorithm for the steady-state solution of conduction-convection problems is discussed. The scheme is applied to a boundary layer problem; in the region where steep gradients occur a higher grid resolution is used. The accumulated mesh is mapped to an equidistant grid by a suitable space-transformation. A corresponding time-transformation has the potential to reduce the computational effort. (orig.)

42257 **(IPP—6/270) Alternative constraints in the entropy principle for tokamak profiles to cylindrical plasmas.** Pfirsch, D.; Pohl, F. (Max-Planck-Institut fuer Plasmaphysik, Garching (Germany, F.R.)). Dec 1987. 25p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88753820/JAW.

The recently proposed variational principle called the 'entropy principle' is now applied with alternative constraints to cylindrical plasmas. These alternative constraints are that the pressure balance relation and Ohm's law with Spitzer conductivity and constant electric field should persist during the variations, replacing the constraint of fixed relations between the plasma pressure and density profiles. This leads to a one-parameter family of slightly paramagnetic equilibria, the parameter being the internal plasma β. The safety factor ratio is found to be about 2. The corresponding plasmas are close to isentropic and their profiles agree reasonably well with Coppi's profile consistence formula for the temperature profiles. A modification of Coppi's formula which greatly improves the agreement is given. (orig.)

42258 **(IPP—6/272) Numerical calculations of localized ideal and resistive instabilities in INTOR equilibria.** Correa-Restrepo, D. (Max-Planck-Institut fuer Plasmaphysik, Garching (Germany, F.R.)). Dec 1987. 27p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88753821/JAW.

The stability of typical INTOR equilibria with respect to localized ideal and resistive instabilities is investigated. Configurations which are stable to ideal ballooning modes (and are therefore also Mercier stable) are shown to be unstable with respect to resistive ballooning instabilities, and the corresponding growth rates are calculated. A useful relation is given which allows calculation of the resistive growth rate at the ideal ballooning limit. This relation is also valid for three-dimensional equilibria. (orig.)

42259 **(IPP—9/57) Routine ion beam analysis of impurities collected on solid probes during plasma experiments.** Boergesen, P.; Svendsen, L.G.; Ehrenberg, J. (Max-Planck-Institut fuer Plasmaphysik, Garching (Germany, F.R.)). Feb 1986. 58p. NTIS (US Sales Only), PC A04/MF A01. Order Number DE88754174/JAW.

A common problem with the use of collector probes in plasma experiments is, that a sensible measurement of distributions of deposits may require the analysis of a very large number of points. For routine application this requires a fast, semiautomatic measurement and data analysis of many data points. The use of RBS and PIXE for this particular purpose is investigated.

42260 **(IPP—III/120) ASDEX contributions to the 14th European conference on controlled fusion and plasma physics.** (Max-Planck-Institut fuer Plasmaphysik, Garching (Germany, F.R.)). Jun 1987. 135p. (CONF-870629—). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88753822/JAW.

From 14. European conference on controlled fusion and plasma physics; Madrid, Spain (22 Jun 1987).

This report is a collection of 25 IPP Garching contributions concerning pellet refuelling, ion-cyclotron resonance heating, lower-hybrid heating and current drive, energy transport studies, particle transport studies, equilibrium and MHD, divertor physics and plasma diagnostics. The contributions have been taken up separately into the data base. (GG)

42261 (IPP—III/120, pp 33-38) **Deposition and erosion at the open and closed ICRH antennae of ASDEX.** Behrisch, R.; Wesner, F.; Wielunski, M.; Noterdaeme, J.M.; Taglauer, E.; Wielunski, M. (Max-Planck-Institut fuer Plasmaphysik, Garching (Germany, F.R.); Institute of Nuclear Research, Warsaw (Poland)). Jun 1987. NTIS (US Sales Only), PC A07/MF A01. Order Number DE88753822/JAW. (CONF-870629—).

From 14. European conference on controlled fusion and plasma physics; Madrid, Spain (22 Jun 1987).

The measured surface composition of the ICRH antenna and protecting limiter elements, dismantled after an operation time of one and a half year, showed an implanted deuterium and metal content which can only be explained by combined deposition and erosion processes during tokamak operation and glow discharge conditioning. Some results also indicate a special ion accelerating process during ICRH just in front of the active part of the antenna. (orig.)

42262 (IPP—III/120, pp 39-42) **Theoretical and experimental investigation of the impact of surface waves and bulk absorption on ICRH fields measured at the plasma edge in tokamaks.** Nieuwenhove, R. van; Koch, R.; Oost, G. van; Gernhardt, J.; Noterdaeme, J.M. (Ecole Royale Militaire, Brussels (Belgium). Lab. de Physique des Plasmas). Jun 1987. NTIS (US Sales Only), PC A07/MF A01. Order Number DE88753822/JAW. (CONF-870629—).

From 14. European conference on controlled fusion and plasma physics; Madrid, Spain (22 Jun 1987).

A planar model which takes into account the periodicity in poloidal and toroidal direction, as well as the radial variation of the toroidal magnetic field, was used to calculate the RF fields in the edge. It is shown that surface waves can exist in a wide plasma parameter range and are excited in TEXTOR in particular. The situation in JET was also examined. Measurements were performed on TEXTOR with small RF pick-up antennas mounted on a radially movable manipulator, in order to determine the electric and magnetic RF field components in two perpendicular directions. The measurements show a wave polarization in agreement with the theoretically predicted existence of surface waves. The measured radial profile of the RF magnetic field shows qualitative agreement with theory. Harmonic generation and a clear anticorrelation between bulk absorption and amplitude of RF fields in the edge were observed, on TEXTOR as well as on ASDEX. Strong asymmetries in the RF fields corresponding to top- and bottom antenna excitation were observed on TEXTOR and compared with ray tracing calculations. (orig.)

42263 (IPP—III/120, pp 59-63) **Measurement of density turbulence and broadband magnetic fluctuations on ASDEX.** Dodel, G.; Holzhauer, E.; Massig, J.; Gernhardt, J. (Stuttgart Univ. (Germany, F.R.). Inst. fuer Plasmaforschung). Jun 1987. NTIS (US Sales Only), PC A07/MF A01. Order Number DE88753822/JAW. (CONF-870629—).

From 14. European conference on controlled fusion and plasma physics; Madrid, Spain (22 Jun 1987).

Significant but distinct changes in the fluctuation spectra have been observed in the various operating regimes of ASDEX. When comparing the behaviour of the density and magnetic field fluctuations it should be kept in mind that the two diagnostics have different spatial weighting functions, defined by the scattering volume in the former case and by the distance from the probe and the mode number m in the latter case. Further experiments will be needed before a comparison with proposed theoretical models for the fluctuations and their propagation mechanism inside the plasma can be made. (orig.)

42264 (IPP—III/120, pp 96-102) **Particle balance in neutral-beam-heated tokamak plasmas.** Becker, G. Jun 1987. NTIS (US Sales Only), PC A07/MF A01. Order Number DE88753822/JAW. (CONF-870629—).

From 14. European conference on controlled fusion and plasma physics; Madrid, Spain (22 Jun 1987).

The particle balance in H discharges in ASDEX during the steady-state ohmic and H phases is investigated by means of transport simulations. Profiles of particle sources and outward and inward flux densities are computed. The magnitude and radial extent of the sources due to cold atoms and beam fuelling and the corresponding convective energy loss are determined. It is further shown that the measured density profiles are not invariant to changes in particle source and confinement. Constraints on the electron heat diffusivity, the diffusion coefficient and the inward drift velocity are derived. An expression representing a lower limit for the diffusion coefficient in the presence of particle sources and inward fluxes is given. (orig.)

42265 (IPP—III/120, pp 103-107) **Fast determination of flux surface structure in ASDEX and ASDEX Upgrade using function parameterisation.** McCarthy, P.J. Jun 1987. NTIS (US Sales Only), PC A07/MF A01. Order Number DE88753822/JAW. (CONF-870629—).

From 14. European conference on controlled fusion and plasma physics; Madrid, Spain (22 Jun 1987).

42266 (IPP—III/120, pp 108-111) **Resistive ballooning stability of ASDEX equilibria.** Zehrfeld, H.P.; Grassie, K. Jun 1987. NTIS (US Sales Only), PC A07/MF A01. Order Number DE88753822/JAW. (CONF-870629—).

From 14. European conference on controlled fusion and plasma physics; Madrid, Spain (22 Jun 1987).

42267 (IPP—III/120, pp 112-115) **Particle density perturbation measurements with schlieren.** Lisitano, G. Jun 1987. NTIS (US Sales Only), PC A07/MF A01. Order Number DE88753822/JAW. (CONF-870629—).

From 14. European conference on controlled fusion and plasma physics; Madrid, Spain (22 Jun 1987).

A new, fast time resolved $\lambda = 2$ mm schlieren diagnostic provides experimental evidence of an $m=1$ particle density perturbation in the plasma interior. (orig.)

42268 (IPP—III/120, pp 127-130) **Nuclear emulsion neutron diagnostics at ASDEX.** Huebner, K.; Baetzner, R.; Hinsch, H.; Hubele, J.; Wolle, B.; Bomba, B.; Rapp, H.; Wurz, H. (Heidelberg Univ. (Germany, F.R.). Inst. fuer Angewandte Physik I). Jun 1987. NTIS (US Sales Only), PC A07/MF A01. Order Number DE88753822/JAW. (CONF-870629—).

From 14. European conference on controlled fusion and plasma physics; Madrid, Spain (22 Jun 1987).

We are using nuclear emulsions at ASDEX to investigate neutron energy spectra and emission profiles and to determine the absolute neutron yield of a discharge. The emulsions are exposed in

collimators which define the observed plasma region and shield them against neutrons emitted and scattered in the rest of the experiment. Two collimators view radially and two others tangentially to the plasma axis, one in the direction of injection (co-collimator), the other in the counter-direction (counter-collimator). An unshielded emulsion was used for the emission profile measurement. One of the radial collimators observes the plasma through the wall of the vessel; all others are positioned in front of the quartz window at the large port. (orig.)

42269 (IPP—III/120, pp 131-134) **VINIA and NEPMC code numerical evaluation of neutron scattering for neutron diagnostics on ASDEX.** Robouch, B.V.; Huebner, K.; Baetzner, R.; Roos, M.; Ingrosso, L.; Rapp, H.; Wurz, H. (Associazione EURATOM-ENEA sulla Fusione, Frascati (Italy). Centro Ricerche Energie; Heidelberg Univ. (Germany, F.R.). Inst. fuer Angewandte Physik 2; Association Euratom-Max-Planck-Institut fuer Plasmaphysik, Garching (Germany, F.R.)). Jun 1987. NTIS (US Sales Only), PC A07/MF A01. Order Number DE88753822/JAW. (CONF-870629—).

From 14. European conference on controlled fusion and plasma physics; Madrid, Spain (22 Jun 1987).

Neutron diagnostics near a tokamak suffer from neutron scattering in the material of the facility and the large extension of the neutron source. We investigate these problems for nuclear emulsion measurements at ASDEX using the VINIA-3DAMC software with a plasma neutron source and the ASDEX structure as input to follow the migration and scattering of neutrons, and the NEPMC software to calculate the nuclear emulsion response. (orig.)

42270 (IPP—III/120, pp 7-14) **Radiation behaviour of gas and pellet refuelled high density discharges in ASDEX.** Mast, K.F.; Mueller, E.R.; Fahrbach, H.U.; Krause, H.; Lang, R.S.; McCarthy, P.; Sandmann, W.; Zasche, D.; Becker, G.; Bosch, H.B. Jun 1987. NTIS (US Sales Only), PC A07/MF A01. Order Number DE88753822/JAW. (CONF-870629—).

From 14. European conference on controlled fusion and plasma physics; Madrid, Spain (22 Jun 1987).

Pellet and gas refuelled high density divertor discharges in ASDEX are investigated with regard to their radiation behaviour and energy balance. Exclusively ohmically heated deuterium plasmas in a non-carbonized (NC), carbonized (C) and titanium gettered (DP) vacuum vessel are considered. In gas refuelled plasmas the radiation power profiles are hollow with a central emissivity $\epsilon(0) \leqq 10$mW/cm/sup 3/ in C and $\epsilon(0) \leqq 40$mW/cm/sup 3/ in NC and DP discharges. In C discharges P/sub RAD//P/sub Ω/ rises from 0.2 at anti n/sub e/ = 3.2 . 10/sup 19/m/sup -3/ to 0.3 at the density limit. In NC and DP plasmas higher values from 0.3 to 0.45 are observed. Radiation from the X-points can amount to 14% of P/sub Ω/. In pellet refuelled discharges a central peaking of the emissivity ϵ is observed. A sudden transition from negligible or slow impurity accumulation to a fast rise could be detected in many discharges. In NC and DP pellet discharges a self-triggering of impurity accumulation was found. Measured inward drift velocities range from 60 cm/s to 130 cm/s at r=15 cm. (orig.)

42271 (IPP—III/120, pp 15-19) **MHD-activities during pellet injection into ohmically and beam heated plasmas on ASDEX.** Kornherr, M.; Gehre, O.; Grassie, K.; Klueber, O.; Mertens, V.; Becker, G.; Bosch, H.S.; Brocken, H.; Buechl, K.; Carlson, A. Jun 1987. NTIS (US Sales Only), PC A07/MF A01. Order Number DE88753822/JAW. (CONF-870629—).

From 14. European conference on controlled fusion and plasma physics; Madrid, Spain (22 Jun 1987).

42272 (IPP—III/120, pp 20-24) **Neoclassical impurity transport in ohmically heated pellet discharges.** Feneberg, W.; Mast, K.F.; Becker, G.; Bosch, H.S.; Brocken, H.; Carlson, A.; Eberhagen, A.; Fahrbach, H.U.; Fussmann, G.; Gehre, O. Jun 1987. NTIS (US Sales Only), PC A07/MF A01. Order Number DE88753822/JAW. (CONF-870629—).

From 14. European conference on controlled fusion and plasma physics; Madrid, Spain (22 Jun 1987).

Pellet refuelled high density divertor discharges in ASDEX which are ohmically heated often show a sudden transition from a status of negligible or slow impurity accumulation to a fast accumulation at the plasma core. From bolometric measurements we estimate the inward drift velocity of medium z impurities and compare the results with theoretical predictions based on the neoclassical momentum equations for a two ion fluid which contain inertia and parallel viscosity. (orig.)

42273 (IPP—III/120, pp 25-28) **Confinement and profile effects during ICRF heating on ASDEX.** Steinmetz, K.; Brambilla, M.; Eberhagen, A.; Wagner, F.; Wesner, F.; Baeumler, J.; Becker, G.; Becker, W.; Braun, F.; Fritsch, R. Jun 1987. NTIS (US Sales Only), PC A07/MF A01. Order Number DE88753822/JAW. (CONF-870629—).

From 14. European conference on controlled fusion and plasma physics; Madrid, Spain (22 Jun 1987).

High power ICRF heating experiments on ASDEX and their comparison with NI heating have shown a unique confinement structure which appears to be inherent to tokamak plasmas. Although profiles are much more peaked with ICRH, their shapes are found to be invariant to modifications of the rf power deposition profiles. Studies on direct electron heating indicate that ion Bernstein waves generated via mode conversion at the 2Ω/sub CH/ resonance layer(s) propagate more than 20 cm towards the inner plasma region while being absorbed along their path. (orig.)

42274 (IPP—III/120, pp 29-32) **Plasma edge effects with ICRF in ASDEX.** Noterdaeme, J.M.; Janeschitz, G.; McCormick, K.; Neuhauser, J.; Roth, J.; Ryter, F.; Taglauer, E.; Tsois, N.; Brambilla, M.; Carlson, A. Jun 1987. NTIS (US Sales Only), PC A07/MF A01. Order Number DE88753822/JAW. (CONF-870629—).

From 14. European conference on controlled fusion and plasma physics; Madrid, Spain (22 Jun 1987).

The evolution of n/sub e/ and T/sub e/ at the plasma boundary during the RF, together with measurements of the floating potential in the divertor, and the analysis of Fe collector probes in the divertor and of the antenna limiter indicate that the enhanced impurity concentration in a ICRF heated plasma is due to a combination of changed transport in the scrape-off layer because of electric fields, and an increased local production of impurities, related to large electric fields in the direct antenna neighbourhood. (orig.)

42275 (IPP—III/120, pp 43-48) **Profile control with lower hybrid waves on ASDEX.** Soeldner, F.X.; McCormick, K.; Leuterer, F.; Becker, G.; Bosch, H.S.; Brocken, H.; Carlson, A.; Eberhagen, A.; Fahrbach, H.U.; Fussmann, G. Jun 1987. NTIS (US Sales Only), PC A07/MF A01. Order Number DE88753822/JAW. (CONF-870629—).

From 14. European conference on controlled fusion and plasma physics; Madrid, Spain (22 Jun 1987).

The correlation between current profile changes and the behavior of MHD modes is studied. Local profile shaping by tailoring of the launched LH wave spectrum is investigated. The impact on electron density and temperature profiles and the relevance of profile consistency are discussed. (orig./GG)

42276 (IPP—III/120, pp 49-52) **Response of plasma profiles to neutral beam power deposition in ASDEX.** Speth, E.; Gruber, O.; Lackner, K.; Staebler, A.; Vollmer, O.; Becker, G.; Bosch, H.S.; Brocken, H.; Carlson, A.; Eberhagen, A. Jun 1987. NTIS (US Sales Only), PC A07/MF A01. Order Number DE88753822/JAW. (CONF-870629—).

From 14. European conference on controlled fusion and plasma physics; Madrid, Spain (22 Jun 1987).

42277 (IPP—III/120, pp 53-58) **Pressure profile consistency in ASDEX discharges.** Gruber, O.; Becker, G.; Bosch, H.S.; Brocken, H.; Carlson, A.; Eberhagen, A.; Fahrbach, H.U.; Fussmann, G.; Gehre, O.; Gernhardt, J. Jun 1987. NTIS (US Sales Only), PC A07/MF A01. Order Number DE88753822/JAW. (CONF-870629—).

From 14. European conference on controlled fusion and plasma physics; Madrid, Spain (22 Jun 1987).

42278 (IPP—III/120, pp 64-69) **ASDEX heat pulse propagation as a forced boundary problem.** Riedel, K.S.; Eberhagen, A.; Becker, G.; Gruber, O.; Lackner, K.; Gehre, O.; Mertens, V.; Neuhauser, J.; Bosch, H.B.; Brocken, H. Jun 1987. NTIS (US Sales Only), PC A07/MF A01. Order Number DE88753822/JAW. (CONF-870629—).

From 14. European conference on controlled fusion and plasma physics; Madrid, Spain (22 Jun 1987).

42279 (IPP—III/120, pp 70-76) **Study of runaway electron confinement to probe the electromagnetic turbulence in OH, L- and H-discharges of ASDEX.** Wagner, F.; Fussmann, G.; Becker, G.; Bosch, H.S.; Brocken, H.; Carlson, A.; Eberhagen, A.; Fahrbach, H.U.; Gehre, O.; Gernhardt, J. Jun 1987. NTIS (US Sales Only), PC A07/MF A01. Order Number DE88753822/JAW. (CONF-870629—).

From 14. European conference on controlled fusion and plasma physics; Madrid, Spain (22 Jun 1987).

Confinement studies of runaway electrons have been performed in order to elucidate the nature of electromagnetic turbulence and its role in ohmically and beam heated L- and H-plasmas. Under ohmic conditions, the confinement time tau/sub R/ of runaway electrons depends strongly on the choice of q/sub a/; in the L-mode, tau/sub R/ degrades with beam power; in the H-phase, runaway electrons are again well confined. With plausible assumptions, a correlation length of the underlying microturbulence of 0.1 cm is found which requires a magnetic perturbation B/sub r//B/ sub o/ ≃ 10/sup -4/ to be consistent with L-mode confinement. (orig.)

42280 (IPP—III/120, pp 77-83) **Study of impurity accumulation in the ASDEX tokamak.** Fussmann, G.; Janeschitz, G.; Becker, G.; Bosch, H.S.; Brocken, H.; Carlson, A.; Eberhagen, A.; Fahrbach, H.U.; Gehre, O.; Gernhardt, J. Jun 1987. NTIS (US Sales Only), PC A07/MF A01. Order Number DE88753822/JAW. (CONF-870629—).

From 14. European conference on controlled fusion and plasma physics; Madrid, Spain (22 Jun 1987).

The internal disruptions are found to play an important role in preventing impurity accumulation. We describe several situations where strong peaking of metallic impurities in the plasma center is observed after suppression of the sawtooth activity. (orig.)

42281 (IPP—III/120, pp 84-91) **Profile evolution and particle transport close to the onset of sawtooth oscillations during the density ramp-up phase in ASDEX.** Gehre, O.; Mertens, V.; Kornherr, M.; Mueller, E.R.; Becker, G.; Bosch, H.S.; Brocken, H.; Carlson, A.; Eberhagen, A.; Fahrbach, H.U. Jun 1987. NTIS (US Sales Only), PC A07/MF A01. Order Number DE88753822/JAW. (CONF-870629—).

From 14. European conference on controlled fusion and plasma physics; Madrid, Spain (22 Jun 1987).

The evolution of the profiles of electron density and temperature soft X-ray (SX) and bolometer radiation is investigated in ASDEX discharges close to the onset of sawteeth. For the transition phase these diagnostics show the signature of a strong sawtooth-like collapse, which removes impurities accumulated in the plasma center. A comparison of electron density transport before and after the transition indicates that the bulk plasma transport has not significantly changed and the observed broadening of the density profile is due to the additional relaxation mechanism of sawteeth. (orig.)

42282 (IPP—III/120, pp 92-95) **Particle transport in sawteeth.** Zasche, D.; Mertens, V.; Gehre, O.; Kaufmann, M.; Roehr, H.; Steuer, K.H.; Becker, G.; Bosch, H.B.; Brocken, H.; Carlson, A. Jun 1987. NTIS (US Sales Only), PC A07/MF A01. Order Number DE88753822/JAW. (CONF-870629—).

From 14. European conference on controlled fusion and plasma physics; Madrid, Spain (22 Jun 1987).

The particle transport in ASDEX discharges with sawtooth oscillations is investigated on time scales comparable to and smaller than the sawtooth period. The net particle flux is calculated using time dependent electron density measurements both from 16-point Thomson scattering and 4-chord FIR interferometer diagnostics. The inward flux during the sawtooth build-up phase at anti n/sub e/ ≃ 5 . 10/sup 19/m/sup -3/ is found to be of the order 10/sup 19/m/sup -2/s/sup -1/ around the radius of the q=1 surface and extends considerably to the outside. This relatively large inward flux is balanced by disruptive outward particle transport during the sawtooth collapse phases, resulting in a quasi-stationary flat density profile. (orig.)

42283 (IPP—III/120, pp 116-122) **Parametric behavior of the density profile in the scrape-off layer of ASDEX for neutral-beam-heated plasmas in the L-regime.** McCormick, K.; Murmann, H.; Becker, G.; Bosch, H.S.; Brocken, H.; Carlson, A.; Eberhagen, A.; Fahrbach, H.U.; Fussmann, G.; Gehre, O. Jun 1987. NTIS (US Sales Only), PC A07/MF A01. Order Number DE88753822/JAW. (CONF-870629—).

From 14. European conference on controlled fusion and plasma physics; Madrid, Spain (22 Jun 1987).

Characterizing the scrape-off layer (SOL) density profile by the density at the separatrix n/sub s/ and the e-folding length λ/sub n/, the SOL is described for a wide variety of conditions: anti n/sub e/ = 1-5 . 10/sup 13/ cm/sup -3/, I/sub p/ = 250-440 kA, B/sub t/ ≃ 22 kG, q/sub a/ = 2.4-4.3 for injected powers P/sub NI/ ≃ 0.4-1.7 MW, which lead to L-type discharges. Generally, λ/sub n/ increases with P/sub NI/, these changes becoming more dramatic for lower I/sub p/ and anti n/sub e/. For OH and NI plasmas n/sub s/ is roughly proportional to anti n/sub e/; the constant of proportionality increases with NI and is independent of P/sub NI/ over the range investigated. (orig.)

42284 (IPP—III/120, pp 123-126) **Langmuir probe measurements in the ASDEX divertor plasma.** Tsois, N.; Haas, G.; Lenoci, M.; Neuhauser, J.; Becker, G.; Bosch, H.S.; Brocken, H.; Carlson, A.; Eberhagen, A.; Fahrbach, H.U. (Democritos Nuclear Research Center, Athens (Greece)). Jun 1987. NTIS (US Sales Only), PC A07/MF A01. Order Number DE88753822/JAW. (CONF-870629—).

From 14. European conference on controlled fusion and plasma physics; Madrid, Spain (22 Jun 1987).

42285 (IPP—III/127) **ASDEX Johann spectrometer.** Lee, R.; Nolte, R. (Max-Planck-Institut fuer Plasmaphysik, Garching (Germany, F.R.); General Atomics Co., San Diego, CA (USA)). Nov 1987. 12p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88753823/JAW.

A Johann spectrometer is a curved crystal instrument whereby X-ray photons are focused by a crystal onto a position sensitive detector. The geometrical relationship between the slit, the crystal and the detector is a circle known as the Rowland circle. Focusing is achieved by bending the crystal such that its radius of curvature is equal to the diameter of the circle. Initial results of test and evaluation of the crystal holders have shown that the micromachined aluminium holders are far superior to the handpolished stainless steel holders. The best focus is 70 μm FWHM in the visible with central 65% of the crystal in proper focus. (orig./GG)

42286 (IPP—III/131) **Confinement studies on ASDEX.** Wagner, F. (Max-Planck-Institut fuer Plasmaphysik, Garching (Germany, F.R.); Heidelberg Univ. (Germany, F.R.)). Feb 1988. 82p. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88753824/JAW.

This report deals with investigations of plasma confinement carried out on the ASDEX divertor tokamak. It is comprised of two sections: The first section deals with the study of the confinement degradation in auxiliary heated sicharges; in the second section a regime will be described where the severe deterioration of the confinement quality at high heating power is avoided. This regime is called the H-mode because of the high confinement characteristics in contrast to the low confinement L-mode. There is evidence that the L-mode characteristics will not lead to sufficient confinement quality for successful plasma burning. The H-mode was observed for the first time on ASDEX. At present it is considered as the confinement regime with the best prospects for future tokamak operation. But both the study of L- and H-mode confine-

ment physics have increased our understanding on energy transport in tokamaks. (orig./GG)

42287 **(IPPCZ—252) Linear mode conversion of waves near the maxima or minima of the density in a warm magnetized plasma.** Hurtak, O.; Preinhaelter, J.; Kopecky, V. (Ceskoslovenska Akademie Ved, Prague. Ustav Fyziky Plazmatu). Sep 1986. 22p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703285/JAW.

Behavior of the high frequency electrostatic waves near the plasma or upper hybrid resonances was studied for the case that these resonances are situated at the maxima or the minima of plasma density. Supposing a parabolic density profile in these regions the connection formulae were obtained for the WKB solutions. In a weakly inhomogeneous magnetoplasma the effect of the parabolic profile manifests itself only in a narrow frequency band centred at the resonance frequency corresponding to the extreme value of the density. The whole process can then be described by only two coefficients, viz., the power conversion and transmission cofficients. (author). 4 figs., 1 tab., 7 refs.

42288 **(IPPCZ—270) Magnetic diagnostic on the CASTOR tokamak.** Valovic, M. (Ceskoslovenska Akademie Ved, Prague. Ustav Fyziky Plazmatu). Apr 1987. 14p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703286/JAW.

The plasma position and Shafranov eccentricity factor were measured on the CASTOR tokamak using magnetic probes. The evolution of the eccentricity factor is illustrated on a discharge with auxiliary non-inductive current drive by lower hybrid waves. (author). 4 figs., 1 tab., 5 refs.

42289 **(IPPCZ—273) Programme of experimental studies on CASTOR tokamak.** Zacek, F.; Badalec, J.; Datlov, J.; Jakubka, K.; Kopecky, V.; Kryska, L.; Magula, P.; Preinhaelter, J.; Stoeckel, K.; Valovic, M. (Ceskoslovenska Akademie Ved, Prague. Ustav Fyziky Plazmatu). (Ceskoslovenska Akademie Ved, Prague. Ustav Fyziky Plazmatu). May 1987. 15p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703287/JAW.

Briefly reviewed is the experimental activity on small tokamak CASTOR, Institute of Plasma Physics, Prague. Work related to the lower hybrid current drive, and RF plasma formation experiments using multijunction waveguide grills as launching antennae are discussed in more detail. A certain insensitivity of the current drive effect to the various types of multijunction grills was observed. A possible reason for this unexpected phenomenon is suggested. (author). 10 figs., 10 refs.

42290 **(IPPCZ—274) Resonance absorption of energy by a cold inhomogeneous plasma.** Sedlacek, Z.; Roberts, B. (Ceskoslovenska Akademie Ved, Prague. Ustav Fyziky Plazmatu; Saint Andrews Univ. (UK). Dept. of Applied Mathematics). (Ceskoslovenska Akademie Ved, Prague. Ustav Fyziky Plazmatu). Jun 1987. 22p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703288/JAW.

The active and reactive power resonantly absorbed by a linear passive system is calculated in terms of its continuum eigenfunctions and the spatial-temporal spectral density of the external force. An application to the resonance absorption of electromagnetic radiation by a cold inhomogeneous plasma is given. (author). 34 refs.

42291 **(IPPJ—854) New mode conversion process and overdense plasma heating in the electron cyclotron range of frequencies.** Nakajima, S.; Abe, H. (Nagoya Univ. (Japan). Inst. of Plasma Physics). Nov 1987. 15p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88754104/JAW.

Through the particle-simulation investigation, a new mode conversion process, through which an incident fast extraordinary mode (fast X mode) is converted into an electron Bernstein mode (B mode) via a slow extraordinary mode (slow X mode), is discovered in plasmas whose maximum density exceeds the cutoff density of the slow X mode. The converted B mode is found to heat the electrons efficiently in an overdense-plasma region, when a plasma has the optimum density gradient at the plasma surface.

42292 **(IPPJ—857) Observation of enhanced electric field in an RF-plugged sheet plasma in the RFC-XX-M open-ended machine.** Oda, T.; Takiyama, K.; Kadota, K. . (Nagoya Univ. (Japan). Inst. of Plasma Physics). Dec 1987. 15p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88754105/JAW.

We report nonperturbing observation of the electric field in the sheet plasma for RF end-plugging on the RFC XX-M open-ended machine by using the Stark effect with a combined technique of beam-probe and laser-induced fluorescence. Under the optimum condition for the RF plugging, enhanced electric field is found in the sheet plasma by about 2.5 times with respect to the electric field when no plasma is produced. The field spatial profile is also measured, which is discussed in connection with the electrostatic eigenmode.

42293 **(IPPJ—858) Electron density profile reconstruction by maximum entropy method with multichannel HCN laser interferometer system on SPAC VII.** Kubo, S.; Narihara, K.; Tomita, Y.; Hasegawa, M.; Tsuzuki, T.; Mohri, A. (Nagoya Univ. (Japan). Inst. of Plasma Physics). Jan 1988. 34p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88753615/JAW.

A multichannel HCN laser interferometer system has been developed to investigate the plasma electron confinement properties in SPAC VII device. Maximum entropy method is applied to reconstruct the electron density profile from measured line integrated data. Particle diffusion coefficient in the peripheral region of the REB ring core spherator was obtained from the evolution of the density profile.

42294 **(ITEF—128(1987)) Heterogeneous equilibrium states of emitting Z-pinches.** Bobrova, N.A.; Razinkova, T.L.; Sasorov, P.V. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1987. 24p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703306/JAW.

Physical conditions, under which the existence of highly heterogeneous equilibrium state of emitting Z-pinches is possible, are determined qualitatively. In the found range of parameters the system of equations is formulated, solutions of which describe the equilibria mentioned. For the purpose the radiation model of heavy element plasma ($20 \leq Z \leq 80$) is developed, which takes into account in the framework of local thermodynamic equilibrium the n,l -> n, l-1 transitions and obstruction of radiating ability in the range of "low" temperatures, where the transitions mentioned are not excited. In the model formulated in case of coordinated increase in the pinch and current per unit length mass the role of heat conductivity decreases but no radiation collapse of the pinch central part takes place, which leads inevitably to pinch plasma stratification into cold and hot phases. 17 refs.; 1 fig.; 2 tabs.

42295 **(ITEF—130(1987)) Peripheral plasma dynamics during neck development in Z-pinch devices.** Sasorov, P.V. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1987. 18p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703307/JAW.

Peripheral plasma dynamics during deep development of commutation in stability under physical conditions characteristic for Z pinch and 'plasma focus' devices is considered. This dynamics determines peripheral plasma parameters till the time when it begins to affect neck development dynamics. The discussion is performed proceeding from obtained during this work analytical solutions of corresponding equations of magnetic hydrodynamics. Situation when finiteness of the peripheral plasma inertia pays an important role,e.g. during 'current break' in pinch plasma and problem of regular acceleration of peripheral plasma ions have been considered. 18 refs.

42296 (JAERI-M—88-006) Lower hybrid current drive for INTOR high density and high temperature operation. Results of the benchmark calculation for INTOR. Hatayama, Akiyoshi; Ushigusa, Kenkichi; Imai, Tsuyoshi; Sugihara, Masayoshi. (Japan Atomic Energy Research Inst., Tokyo). Feb 1988. 21p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88753624/JAW.

Lower hybrid current drive for INTOR high density and high temperature plasma has been studied. The calculational model based on a toroidal ray tracing code and 1-D Fokker-Planck code. RF current profiles are generally not centrally peaked, but localized near plasma surface (r/a ~ 0.65 - 1.0) for the parameter range (n-bar/sub e/ ~ 5 - 7.5 x 10/sup 19/ m/sup -3/ and T-bar/sub e/ ~ 10 - 20 keV) calculated. Effects of wave spectra on the current profile and the current drive efficiency have been studied systematically using the Gaussian spectra with different centeral values N//0 and the widths ΔN//0. The effect of wave launched angle has been also studied. Wave penetration is shown to be effectively improved for the top launched case for n-bar/sub e/ = 5 x 10/sup 19/ m/sup -3/ and T-bar/sub e/ = 12.5 keV.

42297 (JET-R—87-14) XUV spectroscopy in JET during the second semester 1986. Saoutic, B.; Ramette, J.; Mattiolic, M. . (Commission of the European Communities, Abingdon (UK). JET Joint Undertaking). 1987. 84p. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88753991/JAW.

High resolution XUV spectra from JET plasmas have been recorded by a Schwob-Fraenkel 2 m radius grating duo multichannel spectrometer (KT4). Spectra have been systematically investigated under various plasma conditions. Several examples of spectra are presented as well as examples of line time histories chosen in such a way to point out the advantages of the instrument. Doppler shifts and widths of strong spectral lines have also been measured. These measurements, in combination with impurity transport code calculations, have been used to infer radial profiles of plasma toroidal rotation velocity during neutral beam injection and of impurity ion temperature. The intercombination to resonance line intensity ratio of He-like CV has been studied and used to deduce electron temperatures at the radial position of the CV emission shell. Cl contamination, as well as unusual elements, have been observed in some discharges.

42298 (KEK—87-13, pp 46-55) Radio frequency system for nuclear fusion. Kozeki, Shoichiro; Sagawa, Norimoto; Takizawa, Teruhiro. (Hitachi Ltd., Tokyo (Japan)). Sep 1987. (In Japanese). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88780097/JAW. (CONF-8706325—).

From Meeting on high-power, high-frequency power sources; Oho, Japan (4 Jun 1987).

The importance of radio frequency waves has been increasing in the area of nuclear fusion since they are indispensable for heating of plasma, etc. This report outlines radio frequency techniques used for nuclear fusion and describes the development of radio frequency systems (radio frequency plasma heating system and current drive system). Presently, in-depth studies are underway at various research institutes to achieve plasma heating by injection of radio frequency electric power. Three ranges of frequencies, ICRF (ion cyclotron range of frequency), LHRF (lower hybrid range of frequency) and ECRF (electron cyclotron range of frequency), are considered promissing for radio frequency heating. Candidate waves for plasma current driving include ECW (electron cyclotron wave), LHW (lower hybrid wave), MSW (magnetic sound wave), ICW (ion cyclotron wave) with minority component, and FW (fast wave). FW is the greatest in terms of current drive efficiency. In general, a radio frequency system for nuclear fusion consists of a radio frequency power source, transmission/matching circuit component and plasma connection component. (Nogami, K.).

42299 (KFKI—1988-02/D) Thermonuclear plasma physics research in the Central Research Institute for Physics, Hungary. (1986-1987). Bakos, J. (ed.). (Hungarian Academy of Sciences, Budapest. Central Research Inst. for Physics). Jan 1988. 92p. (In Hungarian). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88703435/JAW.

A collection of research projects going on in the Central Research Institute of Physics, Budapest (Hungary) on the various fields of plasma physics is presented. Some research projects are of basic nature, others serve thermonuclear power production. The main papers are indexed separately for the INIS database. (R.P.).

42300 (KFTI—87-33) Calculation of gradient of magnetic surface function and equilibrium current in torsatrons. Nemov, V.V. (AN Ukrainskoj SSR, Kharkov. Fiziko-Tekhnicheskij Inst.). 1987. 6p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88703438/JAW.

Application of magnetic surface function gradient calculation method based on use of magnetic field and its gradient distribution for calculation of this value and plasma equilibrium currents in torsatron and stellarator magnetic configurations is discussed. 6 refs.

42301 (KFTI—87-35) Influence of plasma finite pressure effects on stability of small-scale MHD-modes in a two-turn torsatron. Demchenko, V.V.; Demchenko, P.V.; D'yakov, V.E.; Zhdanov, Yu.A.; Omel'chenko, A.Ya. (AN Ukrainskoj SSR, Kharkov. Fiziko-Tekhnicheskij Inst.). 1987. 20p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703439/JAW.

Equilibrium and stability of finite pressure plasma in a two-turn torsatron are numerically and analytically investigated. Using two-dimensional MHD-code the ultimate plasma pressure value in designed "Uragan-2M" torsatron is determined. It is shown that under off-current operation the magnetic "well" hollow due to finite pressure effects results in stability of ideal small-scale MHD-modes. In this case the maximal β-bar parameter value is defined by plasma filament equilibrium condition and attains 3%. Under conditions of ideal mode stabilization plasma stability relatively to dissipative perturbations build-up, in particular, gravitational-dissipative mode (g-mode) is investigated. A determining role in g-mode destabilization is stated to belong to cubic by plasma pressure components. 36 refs.; 5 figs.

42302 (KFTI—87-40) Excitation of plasma waves by electron bunch. Balakirev, V.A. (AN Ukrainskoj SSR, Kharkov. Fiziko-Tekhnicheskij Inst.). 1987. 9p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88703440/JAW.

Investigation of plasma wave excitation by a charged particle bunch has been carried out. It is shown that the bunch, particle density or transverse dimensions of which increase slowly, in comparison with the plasma period, in the front area and decrease fast in the back one, excites a wake field, which amplitute exceeds considerably the maximum value of the decelerating by the bunch field. The possibility of attenuation of the decelerating field, using field inhomogeneity according to the plasma cross section in a plasma waveguide, is also investigated. 11 refs.

42303 (KFTI—87-41) Multiparticle interactions of Coulomb systems. Panchenko, I.P.; Sevidov, S.M.; Tkach, Yu.V. (AN Ukrainskoj SSR, Kharkov. Fiziko-Tekhnicheskij Inst.). 1987. 12p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703441/JAW.

Dynamics of noncompensated charged particle fluxes in a plasma has been investigated. Stable configurations of bunch-clusters have been found, the problem on their stability in the proper fields has been studied. Interaction processes of two clusters between each other and features of external noncompensated beam propagation in the plasma are considered using numerical methods. Cluster stability has been investigated in the three-dimensional geometry and the process of single particle wake trace excitation has been studied in detail. 20 refs.; 8 figs.

42304 (KFTI—87-42) Theory of cyclotron beam-plasma instabilities. Panchenko, I.P.; Tkach, Yu.V. (AN Ukrainskoj SSR, Kharkov. Fiziko-Tekhnicheskij Inst.). 1987. 14p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703442/JAW.

The processes of beam instability excitation in a magnetoactive plasma are considered. Integral ratios are obtained from a set

of equations describing beam-plasma interactions in the single-mode approximation, analysis of these ratios permitted to obtain estimations of efficiency of oscillation excitation. Dynamics of "wave-particle" system instabilities for beams with different values of the initial Larmor radius has been investigated. Dissipation modes of beam instabilities at resonance of anomalous Doppler effect, when the angles between external magnetic field and wave vectors are arbitrary, are studied numerically. The possibility of compact quasi-particle production on the beam phase plane determining efficiency of particle energy selection is shown. Mechanisms of beam instability restrictions under conditions of the normal Doppler effect are investigated in detail. The set of equations describing the processes of plasma-beam interactions under excitation mode of many oscillation modes at different branches is obtained. Features of dynamics of instability development caused by interaction of oscillation branches are detected. 21 refs.; 9 figs.

42305 **(KFTI—87-43) Theory of parametric instabilities of intensive oscillations in plasma.** Kuklin, V.M.; Panchenko, I.P.; Tkach, Yu.V. (AN Ukrainskoj SSR, Kharkov. Fiziko-Tekhnicheskij Inst.). 1987. 7p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88703443/JAW.

A study was made on the process of excitation of intensive long-wave Langmuir oscillations in plasma by external electromagnetic radiation. The system of equations, describing interaction of pumping wave with Langmuir plasma spectrum was obtained. Numerical analysis of equations showed the possibility of forming quasistationary perturbations of electron and ion plasma components. The effective energy pumping to the short-wave part of the Langmuir spectrum from pumping wave was revealed. Peculiarities of harmonic interaction between each other and with external radiation were studied. Excitation of parameteric instability by high-power relativistic electron beam was considered. Basic characteristics of beam particle interaction with Langmuir plasma oscillations were determined. 19 refs.; 3 figs.

42306 **(KFTI—87-49) Multichannel device for selection and storage of analog information in the CAMAC standard.** Bondarenko, S.P.; Vil'yams, A.P.; Krasnyj, V.V.; Taran, V.S. (AN Ukrainskoj SSR, Kharkov. Fiziko-Tekhnicheskij Inst.). 1987. 6p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88703447/JAW.

A modulus designed for selection and storage of analog information entered from diagnostic apparatus arranged in a plasma installation is described. The number of modulus input channels is 24 and output ones - 6. The principle of internal parallel channel communication is used. Sampling time of four input channels is 25 μs. Selection time of the channel is 3 μs. The maximum input channel is +-2 V. The modulus size is 1 M. 2 refs.; 2 figs.

42307 **(KIYI—87-14) Theory of collisionless motion of high energy alpha-particles in stellarators.** Nagornyj, V.P.; Yavorskij, V.A. (AN Ukrainskoj SSR, Kiev. Inst. Yadernykh Issledovanij). 1987. 48p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703449/JAW.

A theory of high energy alpha particle motion in the classical stellarators is developed. The resonant and non-adiabatic effects such as the resonant broadening of the untrapped particle radial excursions, collisionless orbit transformation and stochasticity of the toroidally trapped particle motion are found to be of great importance in the behaviour of fast alpha particles. 14 refs.; 11 figs.

42308 **(LRP—347/88) Papers contributed to the 15th European conference on controlled fusion and plasma heating.** (Ecole Polytechnique Federale, Lausanne (Switzerland)). May 1988. 44p. (CONF-880534—Exc.). NTIS (US Sales Only), PC A03. Order Number DE88010580/JAW.

From 15. European conference on controlled fusion and plasma heating; Dubrovnik, Yugoslavia (16 May 1988).

These reports cover the topics of: Alfven wave coupling in large Tokamaks; Kinetic and current profile effects of Alfven waves; Alfven wave heating; Shafranov parameter limits for heated plasmas; Ion temperature evolution during Alfven wave heating; Influence of the Alfven wave spectrum on the scrape-off layer of the TCA TOKAMAK: Simulation of plasma control in the TCA with high frequency stabilization; An approach to electrostatic wave problems; Ballooning instabilities. (JF)

42309 **(NIIEFA-P-V—0759) Study on the dynamics of charged particles in a rarefied gas of thermonuclear reactor injector.** Afanas'ev, P.N.; Svistunov, Yu.A.; Sidorov, V.P.; Udovichenko, S.Yu. (Nauchno-Issledovatel'skij Inst. Ehlektrofizicheskoj Apparatury, Leningrad (USSR)). 1987. 16p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703462/JAW.

The motion of an ion beam directly beyond the source is considered in the assumption of homogeneous density of rarefied gas along the injector. Using numerical simulation the dynamics of fast particles in plasma electric field, created by the beam as a result of gas neutral atom ionization, is investigated. It is shown that stationary ambipolar electric field of "plasma lens" can affect considerably the beam transverse dynamics. 9 refs.; 5 figs.

42310 **(PPPL—2519) Characteristics of low-q disruptions in PBX.** Kaye, S.M.; Jahns, G.L.; Morris, A.W.; Sesnic, S.; Bol, K.; Chance, M.; Couture, P.; Fonck, R.; Gammel, G.; Heidbrink, W. (Princeton Univ., NJ (USA). Plasma Physics Lab.). Jun 1988. Contract AC02-76CH03073. 49p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88011873/JAW.

The results of this study indicate that even within the relatively narrow low-q/sub {psi}/ operating space, there is a continuum in the characteristics of the low-q/sub {psi}/ disruptions with a primary dependence on the value of $<\beta/\text{sub } t/>$. While the ideal external kink instability may give rise to the growing oscillations that lead up to the ultimate disruption, the instabilities are weighted towards the edge only at the lowest-q/sub {psi}/ ($\leqq 3$) and highest $<\beta/\text{sub } t/>$. At even slightly higher q/sub {psi}/, the oscillations are also seen, at the same frequency, in the interior of the plasma. The results further indicate that effects outside the scope of ideal MHD theory may play a significant role in low-q/sub {psi}/ disruptions. 34 refs., 19 figs.

42311 **(PPPL—2520) Relaxation phenomena in the high temperature S-1 spheromak.** Ono, Y.; Ellis, R.A. Jr.; Janos, A.C.; Levinton, F.M.; Mayo, R.M.; Motley, R.W.; Ueda, Y.; Yamada, M. (Princeton Univ., NJ (USA). Plasma Physics Lab.). Jun 1988. Contract AC02-76CH03073. 14p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88011874/JAW.

Operation of the S-1 device in a high current density (j/n/sub e/ $\geqq$ 2 {times} 10^{-14}A{center←dot}m) regime has created high electron temperature spheromaks (50eV $\leqq$ T/sub e/ $\leqq$ 130eV). The mechanisms and causes of the periodic relaxation events often observed in these hotter spheromak plasmas were made clear. Also, a relationship between the MHD relaxation cycle and confinement characteristics was revealed for the first time. Resistive loss at the outer edge of the plasma causes a departure from the initial force-free minimum-energy Taylor state to a MHD profile unstable to low-n ideal MHD modes; a relaxation event then returns the configuration to nearly a Taylor state. 11 refs., 5 figs.

42312 **(PPPL—2526) Neutral Probe Beam q-profile measurements in PDX and PBX-M.** Kugel, H.W.; Gammel, G.M.; Kaita, R.; Reusch, M.F.; Roberts, D.W. (Princeton Univ., NJ (USA). Plasma Physics Lab.). Jun 1988. Contract AC02-76CH03073. 17p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88012717/JAW.

Using the Fast Ion Diagnostic Experiment (FIDE) technique, a Neutral Probe Beam (NPB) can be aimed to inject tangentially to a magnetic surface. The resultant ion orbit shifts, due to conservation of canonical toroidal angular momentum, can be measured with a multi-sightline charge-exchange analyzer to yield direct measurements of radial magnetic flux profiles, current density profiles, the radial position of the magnetic axis, flux surface inner and outer edges, q-profiles, and central-q time dependencies. An extensive error analysis was performed on previous PDX q-measurements in circular plasmas and the resulting estimated contributions of various systematic effects are discussed. Preliminary results of

fast ion orbit shift measurements at early times in indented PBX-M plasmas are given. Methods for increasing the absolute experimental precision of similar measurements in progress on PBX-M are discussed. 4 refs., 3 figs.

42313 **(PPPL—2528) Plasma diagnostics for the compact ignition tokamak.** Medley, S.S.; Young, K.M. (Princeton Univ., NJ (USA). Plasma Physics Lab.). Jun 1988. Contract AC02-76CH03073. 36p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88012718/JAW.

The primary mission of the Compact Ignition Tokamak (CIT) is to study the physics of alpha-particle heating in an ignited D-T plasma. A burn time of about 10 {tau}/sub E/ is projected in a divertor configuration with baseline machine design parameters of R=2.10 m, 1=0.65 m, b=1.30 m, I/sub p/=11 MA, B/sub T/=10 T and 10-20 MW of auxiliary rf heating. Plasma temperatures and density are expected to reach T/sub e/(O) {approximately}20 keV, T/sub i/(O) {approximately}30 keV, and n/sub e/(O) {approximately} 1 {times} 10^{21}m/sup {minus}3/. The combined effects of restricted port access to the plasma, the presence of severe neutron and gamma radiation backgrounds, and the necessity for remote of in-cell components create challenging design problems for all of the conventional diagnostic associated with tokamak operations. In addition, new techniques must be developed to diagnose the evolution in space, time, and energy of the confined alpha distribution as well as potential plasma instabilities driven by collective alpha-particle effects. The design effort for CIT diagnostics is presently in the conceptual phase with activity being focused on the selection of a viable diagnostic set and the identification of essential research and development projects to support this process. A review of these design issues and other aspects impacting the selection of diagnostic techniques for the CIT experiment will be presented. 28 refs., 10 figs., 2 tabs.

42314 **(PPPL—2530) Survey of features in radiative power loss profiles in TFTR.** Schivell, J.; Bush, C.E.; Mansfield, D.K.; Medley, S.S.; Park, H.K.; Stauffer, F.J. (Princeton Univ., NJ (USA). Plasma Physics Lab.). Jun 1988. Contract AC02-76CH03073. 34p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88012995/JAW.

Although the total radiated power in TFTR is often as high as 70% of the heating power, most of the radiation is concentrated near the surface of the plasma, and the interior loss is almost negligible. Fractional radiation loss declines during neutral beam heating. As the high-density limit is approached, under practically any conditions, a bright band of radiation ("marfe") appears on the inner side of the plasma column. Marfe evolution has been tracked for various conditions of heating, magnetic field direction, and fueling. In enhanced-confinement discharges a peculiar bright band, distinct from a marfe, appears in the lower, outside part of the vacuum vessel, outside of the limiter radius. With pellet fueling, marfe evolution occurs at a higher average density, and an intense peak often appears in the plasma center, consisting of impurity radiation plus working-gas bremsstrahlung. In high density ohmically heated cases with pellet fueling radiative power loss exceeds heating power in the center. 34 refs., 19 figs.

42315 **(PPPL—2531) Transport simulations of a density limit in radiation-dominated tokamak discharges: Profile effects.** Stotler, D.P. (Princeton Univ., NJ (USA). Plasma Physics Lab.). Jun 1988. Contract AC02-76CH03073. 44p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88012996/JAW.

The density limit observed in tokamak experiments is thought to be due to a radiative collapse of the current channel. A transport code coupled with an MHD equilibrium routine is used to determine the detailed, self-consistent evolution of the plasma profiles in tokamak discharges with radiated power close to or equalling the input power. The present work is confined to ohmic discharges in steady state. It is found that the shape of the density profile can have a significant impact on the variation of the maximum electron density with plasma current. Analytic calculations confirm this result. 41 refs., 9 figs.

42316 **(PPPL—2532) Alpha-particle effects on high-n instabilities in tokamaks.** Rewoldt, G. (Princeton Univ., NJ (USA). Plasma Physics Lab.). Jun 1988. Contract AC02-76CH03073. 37p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88012997/JAW.

Hot α-particles and thermalized helium ash particles in tokamaks can have significant effects on high toroidal mode number instabilities such as the trapped-electron drift mode and the kinetically calculated magnetohydrodynamic ballooning mode. In particular, the effects can be stabilizing, destabilizing, or negligible, depending on the parameters involved. In high-temperature tokamaks capable of producing significant numbers of hot α-particles, the predominant interaction of the mode with the α-particles is through resonances of various sorts. In turn, the modes can cause significant anomalous transport of the α-particles and the helium ash. Here, results of comprehensive linear eigenfrequency-eigenfunction calculations are presented for relevant realistic cases to show these effects. 24 refs., 12 figs., 6 tabs.

42317 **(PPPL—2534) A unified theory of tokamak transport via the generalized Balescu--Lenard collision operator.** Mynick, H.E.; Duvall, R.E. (Princeton Univ., NJ (USA). Plasma Physics Lab.). Jun 1988. Contract AC02-76CH03073. 45p. NTIS, PC A03. Order Number DE88012719/JAW.

A unified basis from which to study the transport of tokamaks at low collisionality is provided by specializing the "generalized Balescu--Lenard" collision operator to toroidal geometry. Explicitly evaluating this operator, ripple, turbulent, and neoclassical transport coefficients are obtained, simply by further specializing the single operator to different particular classes of fluctuation wavelength and mode structure. For each class of fluctuations, the operator possesses a diffusive, test-particle contribution D, and in addition a dynamic drag term F, which makes the operator self-consistent, and whose presence is accordingly essential for the resultant fluxes to possess the appropriate conservation laws and symmetrics. These properties, well-known for axisymmetric transport, are demonstrated for one type of turbulent transport, chosen for definiteness, by explicit evaluation of both "anomalous diffusion" term arising from D, as well as the closely related test particle calculations, but is shown to have an important impact on the predicted fluxes. 16 refs., 1 fig.

42318 **(PPPL—2535) Alpha storage regime in high temperature sub-ignited D-T tokamaks.** Zweben, S.J.; Furth, H.P.; Mikkelsen, D.R.; Redi, M.H.; Strachan, J.D. (Princeton Univ., NJ (USA). Plasma Physics Lab.). Jul 1988. Contract AC02-76CH03073. 40p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88012720/JAW.

Alpha particle parameters in sub-ignited D-T tokamaks like TFTR can be optimized in a high temperature "alpha storage regime " in which the alpha particle thermalization time {tau}/sub α/ is long ($\sim$1.0 sec) and in which the alpha particle source rate S/sub α/ is enhanced due to a beam-target and beam-beam reactions (by a factor of $\sim$2-3). Near reactor-level alpha instability parameters β/sub α/(0) $\sim$ n/sub α/(0)/n/sub e/(O) $\sim$ 1% are predicted by simulation codes when Q $\sim$ 0.5-1, while present TFTR "supershots" already have β/sub α/(O) $\sim$ n/sub {alpha}(O)/n{sub e}(O) {approx} 0.1-0.2%. Plasmas in this regime can be used to test theories of collective alpha instabilities for the first time, and can be used to provide a strong (but transient) alpha heating pulse. An experimental scenario to exploit this regime is described. 28 refs., 5 figs., 5 tabs.,

42319 **(UCB/ERL-M—88/23) Collector and source sheaths of a finite ion temperature plasma.** Schwager, L.A.; Birdsall, C.K. (California Univ., Berkeley (USA). Electronics Research Lab.). 13 Apr 1988. Contract FG03-86ER53220. 46p. NTIS, PC A04/MF A01;1; GPO Dep. Order Number DE88008934/JAW.

The region between a Maxwellian plasma source and an absorbing surface is modeled with an electrostatic particle simulation and with a kinetic plasma-sheath model. In the kinetic model, Poisson's equation and Vlasov equations govern the velocity distribution of the ions and electrons. Our numerical and theoretical re-

sults for collector potential and plasma transport agree with the bounded model of Emmert et al., but differ somewhat from those using traditional Bohm sheath analysis. The plasma source injects equal fluxes of half-Maxwellian ions and electrons with specified mass and temperature ratios and is assumed to have a zero electric field. Representing the potential change within a distributed full-Maxwellian source region, the source potential drop depends primarily on temperature ratio and evolves a few Debye lengths from the source to neutralize the injected plasma. The plasma flows to an electrically floating collector where the more familiar electron-repelling collector sheath appears. Profiles of potential, density, drift velocity, temperature, kinetic energy flux, and heat flux are shown from simulation; all compare very well with theory. 24 refs., 7 figs., 1 tab.

42320 **(UCID—21403) Bremsstrahlung from high Z impurities in hot plasmas.** DeWitt, H.; Rogers, F.; Iglesias, C. (Lawrence Livermore National Lab., CA (USA)). 9 May 1988. Contract W-7405-ENG-48. 19p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88011755/JAW.

This is a study of the effect of core electron and plasma screening on Bremsstrahlung from high-Z impurities in hot plasmas. 3 refs., 7 figs., 1 tab.

42321 **(UCID—21429) Efficiency calculations for the direct energy conversion system of the Cadarache neutral beam injectors.** White, R.C. (Lawrence Livermore National Lab., CA (USA)). 8 Jun 1988. Contract W-7405-ENG-48. 14p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88012450/JAW.

A prototype energy conversion system is presently in operation at Cadarache, France. Such a device is planned for installation on each six neutral beam injectors for use in the Tore Supra experiment in 1989. We present calculations of beam performance that may influence design considerations. The calculations are performed with the DART charged particle beam code. We investigate the effects of cold plasma, direct energy conversion and neutral beam production. 4 refs., 6 figs., 4 tabs.

42322 **(UCRL—53870) Measurements of radial profiles of ion cyclotron resonance heating on the Tandem Mirror Experiment-Upgrade.** Falabella, S. (Lawrence Livermore National Lab., CA (USA)). 11 May 1988. Contract W-7405-ENG-48. 155p. NTIS, PC A08/MF A01; 1; GPO Dep. Order Number DE88013164/JAW.

A small Radial Energy Analyzer (REA) was used on the Tandem Mirror Experiment-Upgrade (TMX-U), at Lawerence Livermore National Laboratory, to investigate the radial profiles of ion temperature, density, and plasma potential during Ion Cyclotron Resonance Heating (ICRH). The probe has been inserted into the central-cell plasma at temperatures of 200 eV and densities of 3 x 10^{12}cm/sup {minus 3}/ without damage to the probe, or major degradation of the plasma. This analyzer has indicated an increase in ion temperature from near 20 eV before ICRH to near 150 eV during ICRH, with about 60 kW of broadcast power. The REA measurements were cross-checked against other diagnostics on TMX-U and found to be consistent. The ion density measurement was compared to the line-density measured by microwave interferometry and found to agree within 10 to 20%. A radial intergral of n/sub i/T/sub i/ as measured by the REA shows good agreement with the diamagnetic loop measurement of plasma energy. The radial density profile is observed to broaden during the RF heating pulses, without inducing additional radial losses in the core plasma. The radial profile of plasma is seen to vary from axially peaked, to nearly flat as the plasma conditions carried over the series of experiments. To relate the increase in ion temperature to power absorbed by the plasma, a power balance as a function of radius was performed. The RF power absorbed is set equal to the sum of the losses during ICRH, minus those without ICRH. This method accounts for more than 70% of the broadcast power using a simple power balance model. The measured radial profile of the RF heating was compared to the calculations of two codes, ANTENA and GARFIELD, to test their effectiveness as predictors of power absorption profiles for TMX-U. 62 refs., 63 figs., 7 tabs.

42323 **(UCRL—96656) TMX-U [Tandem Mirror Experiment Upgrade] ECRH [Electron Cyclotron Resonant Heating] system operations summary.** Heefner, J.W.; Brooksby, C.A.; Lauze, R.R.; Karsner, P.G. (Lawrence Livermore National Lab., CA (USA)). 7 Oct 1987. Contract W-7405-ENG-48. 4p. (CONF-871007—99). NTIS, PC A02/MF A01;1; GPO Dep. Order Number DE88011324/JAW.

From 12. symposium on fusion engineering; Monterey, CA, USA (12 Oct 1987).

The TMX-U ECRH System underwent many extensive changes during the last two years of physics operations. These changes included extensive use of fiber optics and computer control to add flexibility to the system and eliminate noise problems, upgrades to Varian Model VGA-8050M long pulse gyrotron tubes, the addition of gyrotron anode-modulation for better control of individual gyrotrons, and the installation of a fifth gyrotron socket that was used to simultaneously heat both the east and west inner 10 KG locations. This paper discusses the different modifications made to the system and their effects on the overall performance of the entire ECRH system. The paper also discusses the system as it presently exists and possible modifications that would be made if the future modifications were to be performed. 3 refs., 2 figs.

42324 **(UCRL—96670) Video digitizer (real time-frame grabber) with region of interest suitable for quantitative data analysis used on the infrared and H alpha cameras installed on the DIII-D experiment.** Ferguson, S.W.; Kevan, D.K.; Hill, D.N.; Allen, S.L. (Lawrence Livermore National Lab., CA (USA)). 7 Oct 1987. Contract W-7405-ENG-48. 5p. (CONF-871007—96). NTIS, PC A02/MF A01;1; GPO Dep. Order Number DE88011327/JAW.

From 12. symposium on fusion engineering; Monterey, CA, USA (12 Oct 1987).

This paper describes a CAMAC based video digitizer with region of interest (ROI) capability that was designed for use with the infrared and H alpha cameras installed by Lawrence Livermore Laboratory on the DIII-D experiment at G.A. Technologies in San Diego, California. The video digitizer uses a custom built CAMAC video synchronizer module to clock data into a CAMAC transient recorder on a line-by-line basis starting at the beginning of a field. The number of fields that are recorded is limited only by the available transient recorder memory. In order to conserve memory, the CAMAC video synchronizer module provides for the alternative selection of a specific region of interest in each successive field to be recorded. Memory conservation can be optimized by specifying lines in the field, start time, stop time, and the number of data samples per line. This video frame grabber has proved versatile for capturing video in such diverse applications as recording video fields from a video tape recorder played in slow motion or recording video fields in real time during a DIII-D shot. In other cases, one or more lines of video are recorded per frame to give a cross sectional slice of the plasma. Since all of the data in the digitizer memory is synchronized to video fields and lines, the data can be read directly into the control computer in the proper matrix format to facilitate rapid processing, display, and permanent storage. 8 figs.

42325 **Beam—plasma dispersion relations by Lorentz transformation.** McKinstrie, C.J. (Los Alamos National Laboratory, Los Alamos, New Mexico 85745). *Physics of Fluids;* 31: No. 5, 1273-1276(May 1988). Contract W-7405-ENG-36.

The dispersion tensor for linear wave propagation in an arbitrary number of moving plasma species is derived using an approach that is based on Lorentz transformations. This approach requires less computational effort than the direct approach, in which the equation of motion for each plasma species is linearized about an equilibrium state with nonzero velocity v/sub s/. As a specific example, the effects of an axial magnetic field and transverse beam temperature on the collisionless Weibel instability are studied.

42326 **Ion transport theory for a strongly-rotating beam-injected tokamak plasma.** Neeley, G.W. Atlanta, GA; Georgia Institute of Technology (1987). 325p. University Microfilms Order No. 87-18,457.

Thesis (Ph. D.).

The kinetic theory of ion transport in axisymmetric tokamak plasmas was extended to include the effects of strong plasma rota-

tion and radial viscous momentum transfer due to unbalanced neutral beam injection. To accommodate particle flow speeds which are comparable in magnitude to the ion's thermal velocity, the kinetic analysis is carried out in a coordinate frame which is moving with the plasma. As a result, the kinetic transport equations are a simple generalization of the kinetic equations valid for non-rotating plasmas with the radial gradient of the toroidal angular velocity appearing as a driving term like the temperature gradient. An ordered hierarchy of kinetic equations are obtained for both the gyroangle dependent and gyrotropic components of the particle distribution function by expanding the particle distribution function, electric-field vector, and particle flow in powers of the gyroradius parameter. The collisional response of the plasma to intense momentum injection is obtained by use of a linearized Fokker-Planck collision operator which accounts for both the direct and indirect effects of beam particle collisions with the background plasma species. Finally, the fluid equations are used in conjunction with the kinetically derived constitutive relationships to obtain an expression for the radial particle flux for a mixed-regime-beam injected plasma.

42327 **Dependence of MHD stability of a plasma on the ratio of the densities of energetic and background particles.** Olson, L.B. Princeton, NJ; Princeton Univ. (1987). 162p. University Microfilms Order No. 87-24,795.

Thesis (Ph. D.).

This work addresses the physics of a plasma that has two electron populations with very different temperatures. Electron-cyclotron-resonance heating is used to heat the electrons and produce a cold collisional component (1-20eV) and a hot collisionless component (~ 1 keV). Striking changes are observed depending on the ratio of these two electron populations. This ratio can be controlled by changing the rf power and neutral pressure or by looking at different times during the plasma decay. The hot electrons are lost much faster than the cold electrons, with decay times of tens of microseconds as opposed to milliseconds. The experiments were performed on a single-cell mirror device, LAMEX. One result is that the background plasma can be stabilized against the interchange mode by raising the hot-electron fraction above a threshold value. The important point is that it is the hot-electron density rather than the beta which does the stabilizing. The second finding is that the hot electrons are rapidly lost due to two high-frequency instabilities, the hot-electron interchange, and the compressional Alfven mode. One of these is always active, though never at the same time. The hot-electron interchange is unstable when the hot-electron fraction is too high, and the compressional alfven mode is unstable when the hot-electron fraction is too low.

42328 **Experimental study of scattered waves and cylindrical antenna sheaths in a microwave-driven plasma.** Kodis, M.A. Davis, CA; Univ. of California (1987). 123p. University Microfilms Order No. 87-23,401.

Thesis (Ph. D.).

A short-wire antenna is immersed in a quiescent, weak-gradient underdense plasma. The system is irradiated at low power with 1.2 GHz microwaves. Spectra received from the antenna show three strong down-scattered frequencies: the half-harmonic of the driver and a pair of frequencies equidistant above and below the driver. These frequencies are described as the symmetric pair. Growth and decay of these signals, their variation with the plasma density, and the effects of the antenna sheath are investigated with a view to distinguishing among various processes suggested for their generation. Two hypotheses in particular were tested: (1) can two-plasmon decay be distinguished from parametric sheath instability by controlling conditions in the probe sheath? (2) Is the high-frequency peak of the symmetric pair an electromagnetic wave, confirming it as Raman scattering? Based on the experiments reported here, it is postulated that gradient-driven two-plasmon Decay in the sheath and/or presheath of the probe is the source of the half-harmonic signal. The extreme plasma-density gradients found in a sheath offer high-growth-rate conditions for this parametric instability. The observed threshold lies between the thresholds calculated for the cases of collisional and convective losses. The very-low minimum density suggests that Landau damping is suppressed in the sheath.

42329 **Plasma motion during the formation phase of the PS-3 and PS-3.5 spheromaks.** Peyser, T.A. College Park, MD; Univ. of Maryland (1987). 265p. University Microfilms Order No. 87-25,549.

Thesis (Ph. D.).

Spectroscopic Doppler-shift measurements of C III impurity ion in the ultraviolet are reported from the University of Maryland spheromak experiments PS-3 ad PS-3.5. A new time- and space-resolved Doppler-shift diagnostic with absolute wavelength calibration to +/- 0.02 A is described. Large-velocity fields (on the order of the Alfven speed) observed in both the PS-3 and PS-3.5 experiments during the formation phase, but not during the equilibrium, suggest that flow fields may play an important role in the reconnection and relaxation process. The standard theory of Taylor relaxation may need to be modified in order to include the effects of bulk plasma motion. Doppler-shift measurements of the C III 2296.87-A impurity-emission line in the PS-3.5 spheromak were made side-on above and below the machine axis. During the formation phase, blue shifts are observed below and red shifts observed above the axis suggesting a toroidal rotation in the direction of the confined-plasma diamagnetic drift. The plasma emissivity near the C III wavelength was obtained from Abel inversion of the line-integrated intensities. Computer modeling of velocity fields, emissivity profiles, and line shapes is used to interpret the experimental data.

42330 **Physics analysis of the TIBER-II engineering test reactor.** Uckan, N.A.; Houlberg, W.A.; Attenberger, S.E.; Dory, R.A.; Spong, D.A.; Tolliver, J.S.; Sheffield, J. (Oak Ridge National Lab., PO Box Y, Oak Ridge, TN (US)). pp 1428-1433 of Proceedings of the 12th symposium on fusion engineering. Piscataway, NJ; IEEE Service Center (1987). (CONF-871007—).

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Confinement capability, burn characteristics, heating and fueling requirements, and fast-alpha particle effects are assessed for the TIBER-II engineering test reactor (ETR/ITER). Confinement predictions for a wide variety of empirical scaling laws show that ignition on TIBER-II (or similar ETR-like devices) is marginal at 10 MA, whereas the design goal to achieve noninductively driven, steady-state burn with $Q > 5$ can easily be attained. Operation at the higher plasma currents being discussed for ITER or the attainment of higher density limits and/or favorable H-mode scalings improves the ignition capability. Pellet penetration calculations indicate that density profile control with pellets may not be feasible even for pellet velocities up to bout 50 km/s; however, density peaking could result from inward pinch effects, as frequently inferred from experiments. The fast alpha contribution to pressure is substantial (10-30%) at TIBER (or any ETR/ITER) burn temperatures (8-20 keV). A relatively low level of fast alpha radial diffusion or a modest level of thermal alpha buildup significantly influences the ignition and steady-state burn capability. The fast alpha population can also modify the background plasma ballooning mode stability boundaries, lowering the beta limit β/sub crit/ - in particular, operation at the high electron temperatures needed for efficient current drive can exacerbate this effect. The use of high-energy neutral beams offers the promise of two important improvements in projected performance: an effective method for noninductive current drive and a means for controlling the current density profile deep within the plasma, as required for stable operation at high beta levels.

42331 **Poloidal magnetics and divertor strike point control in the Compact Ignition Tokamak.** Strickler, D.J.; Peng, Y.K.M.; Sayer, R.O.; Jardin, S.C.; Rotolante, A.M. (Fusion Engineering Design Center, Oak Ridge, TN 37831 (US)). pp 1424-1427 of Proceedings of the 12th symposium on fusion engineering. Piscataway, NJ; IEEE Service Center (1987). (CONF-871007—).

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The Compact Ignition Tokamak (CIT) is proposed to achieve short-pulse ignition and to study the physics of alpha-particle heating in a minimum-sized tokamak. The level of energy confinement required for ignition leads to a high-field (B/sub t/ = 10 T) device with a large plasma current I/sub p/ = 9 MA). System

studies have resulted in a baseline design with major radius R = 1.75 m, minor radius a = 0.55 m, elongation b/a = 2.0, and q = 3.5 where elongation and q are measured at the 95% flux surface. The poloidal field (PF) system for the CIT is designed for double-null divertor operation at a plasma current of 4.5 MA ≦ I/sub p/ ≦ 9.0 MA. Device physics specifications require that divertor operation be possible over a significant range of plasma profiles (e.g., 0.1 ≦ β/sub p/ ≦ 0.8 and 0.3 ≦ l/sub i/ ≦ 0.5) and plasma shapes (e.g., 1.6 ≦ b/a ≦ 2.0 at l/sub p/ - 6.3 MA) using mainly external PF windings. Further, it should be possible to vary, in a controlled manner, the points at which the separatrix flux surfaces intersects the divertor plates by using some combination of external coils and internal coils of modest current. Methods are presented for computing free-boundary equilibria with prescribed major radius, minor radius, PF volt-seconds, and (a) divertor X-point coordinates or (b) divertor strike-point coordinates. These methods are applied in the analysis of the CIT PF system. Equilibrium solutions satisfying the above criteria yield external PF coil currents and PF coal energies that vary over a large range for the specified range of plasma profiles. A numerical optimization technique is used to find solutions of minimum PF energy.

42332 **Transport simulations of ohmic ignition experiment - IGNITEX.** Uckan, N.A.; Howe, H.C. (Oak Ridge National Lab., P.O. Box Y, Oak Ridge, TN (US)). pp 1398-1401 of Proceedings of the 12th symposium on fusion engineering. Piscataway, NJ; IEEE Service Center (1987). (CONF-871007—).

From 12. symposium on fusion engineering; Monterey, CA, USA (12 Oct 1987).

The IGNITEX device is a compact, super-high-field, high-current, copper-coil tokamak envisioned to reach ignition with ohmic (OH) heating alone. Several simulations of IGNITEX were made with a O-D global model and with the 1-D PROCTR transport code. It is shown that OH ignition is a sensitive function of the assumptions about density profile, wall reflectivity of synchrotron radiation, impurity radiation, plasma edge conditions, and additional anomalous losses. In IGNITEX, OH ignition is accessible with nearly all scalings based on favorable OH confinement (such as neo-Alcator). Also, OH ignition appears to be accessible for most (not all) L-mode scalings (such as Kaye-Goldston), provided that the density profile is not too broad (parabolic or more peaked profiles are needed), Z/sub eff/ is not too large (≦2), and anomalous radiation and alpha losses and/or other enhanced transport losses (eta/sub i/ modes, edge convective energy losses, etc.) are not present. In IGNITEX, because the figure-of-merit parameters (aB/sub o//sup 2//q . — IB/sub o/, etc.) are large, ignition can be accessed (either with OH heating alone or with the aid of a small amount of auxiliary power) at relatively low beta, far from stability limits. Once the plasma is ignited, thermal runaway is prevented naturally by a combination of increased synchrotron radiation, burnout of the fuel in the plasma core and replacement by thermal alphas, and the reduction in the thermal plasma confinement assumed in L-mode-like scalings.

42333 **Synchrotron radiation losses in ETRs.** Uckan, N.A. (Oak Ridge National Lab., P.O. Box Y, Oak Ridge, TN (US)). pp 1394-1397 of Proceedings of the 12th symposium on fusion engineering. Piscataway, NJ; IEEE Service Center (1987). (CONF-871007—).

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In next-generation Engineering Test Reactors (ETRs), one major objective is envisioned to be a long-pulse or steady-state burn using noninductive current drive. At the high temperatures needed for efficient current drive, synchrotron radiation could represent a large power loss, especially if wall reflectivity (R) is very low. Many INTOR-class ETR designs (FER, NET, OTR, TIBER, etc.) call for carbon-covered surfaces for which wall reflectivity is uncertain. Global radiation losses are estimated for these devices using empirical expressions by Trubnikov (and others). Various operating scenarios are evaluated under the assumption that the plasma performance is limited by either the density limit (typical of the ignition phase) or the beta limit (typical of the current drive phase). For a case with ≧90% wall reflectivity, synchrotron radiation is not a significant contribution to the overall energy balance (the ratio of synchrotron to alpha power is less than 10-20%, even at <T/sub e/> — 30 keV) and thus should not adversely alter performance in these devices. In extreme cases with 0% wall reflectivity, the ratio of synchrotron radiation to alpha power may approach 30-60% (depending on the device and limiting operating scenario), adversely affecting the performance characteristics.

42334 **Modeling and transport simulations of the Oscillating Field Current Drive in the reversed field pinch.** Scardovelli, R.A.; Miley, G.H.; Nebel, R.A.; Werley, K.A. (Fusion Studies Lab., Univ. of Illinois, Urbana, IL (US)). pp 1390-1393 of Proceedings of the 12th symposium on fusion engineering. Piscataway, NJ; IEEE Service Center (1987). (CONF-871007—).

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A scenario for a cycle of the Oscillating Field Current Drive (OFCD) oscillations has been developed in terms of the evolution of the q profile. Modulations of the applied toroidal and poloidal voltages, have been associated to two different classes of m = 1 current-driven tearing modes: one responsible for the dynamo activity and the other for the current drive. These results provide an interpretation of recent experiments and provide a model for evaluation OFCD for reactor applications.

42335 **Edge-plasma analysis for the Titan reversed-field-pinch reactor.** Prinja, A.K.; Cooke, P.I.H.; Vold, E.L. (Dept. of Mechanical, Aerospace and Nuclear Engineering and Institute for Plasma and Fusion Research, Univ. of California at Los Angeles, Los Angeles, CA (US)). pp 1386-1389 of Proceedings of the 12th symposium on fusion engineering. Piscataway, NJ; IEEE Service Center (1987). (CONF-871007—).

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The edge-plasma and neutral-particle transport analysis for the TITAN reversed-field-pinch reactor is described. A trace amount of a high-Z impurity (xenon) is injected into the plasma to create a highly radiative model of operation, in which most of the steady-state heating power is radiated in the core, edge and divertor plasma, leaving only a small fraction to be removed by the target plates of the three toroidal-field divertors. Sputtering erosion of the first wall is small because of the low plasma temperature caused by the intense radiative cooling; a high-Z material (tungsten-rhenium) is required for the divertor target to ensure an acceptable erosion rate. Neutral transport simulations indicate significant helium enrichment of the gas escaping to the vacuum pumps.

42336 **Initial results of systems analysis of the ETR/ITER design space.** Peng, Y.K.M.; Galambos, J.D.; Reid, R.L.; Strickler, D.J.; Kalsi, S.; Deleanu, L. (Fusion Engineering Design Center, Fusion Energy Div., Oak Ridge National Lab., P.O. Box Y, Oak Ridge, TN (US)). pp 1382-1385 of Proceedings of the 12th symposium on fusion engineering. Piscataway, NJ; IEEE Service Center (1987). (CONF-871007—).

From 12. symposium on fusion engineering; Monterey, CA, USA (12 Oct 1987).

Preliminary versions of the Engineering Test Reactor (ETR) systems code TETRA (Tokamak Engineering Test Reactor Analysis), which determines design solutions by the method of constrained optimization, are used to characterize the International Thermonuclear Experimental Reactor (ITER) and its design parameter space. The authors find that the physics objectives of high ignition margin and high plasma current lead to minimum size at relatively low aspect ratios (A = 2.5-3.0), while the engineering objective of high neutron wall load (W/sub L/ ≧ 1.0 MW/m/sup 2/) leads to minimum size at higher A (—3.5). For minimum-size ITERs, the optimal toroidal field coil (TFC) designs fall within a narrow range of maximum fields (10-11 T) with R varying over only a few percent despite a factor of two change in the winding pack current density J/sub wp/. The major radius of the design is found to be sensitive to changes in elongation, inboard distances (such as plasma scrape-off), inductive flux capability, plasma temperature, beta limit, and ignition margin A preliminary characterization of the U.S. ITER designs with plasma current I/sub p/ > 15 MA and R < 4.5 m has been obtained by combining the engi-

neering assumptions for devices such as the Tokamak Ignition/Burn Engineering Reactor (TIBER) with the physics assumptions for devices such as the Compact Ignition Tokamak (CIT) and the Next European Torus (NET). These devices can accommodate a range of full- to reduce-bore, driven (Q < 10), steady-state plasmas for the engineering phase that produces high neutron wall load and fluence.

42337 **Ignition in near term D-/sup 3/He tokamak reactors.** Emmert, G.A.; Deng, B.Q. (Fusion Technology Institute, Dept. of Nuclear Engineering and Engineering Physics, Univ. of Wisconsin-Madison, 1500 Johnson Drive, Madison, WI (US)). pp 1362-1364 of Proceedings of the 12th symposium on fusion engineering. Piscataway, NJ; IEEE Service Center (1987). (CONF-871007—).

From 12. symposium on fusion engineering; Monterey, CA, USA (12 Oct 1987).

The prospects for achieving breakeven and ignition in near term ETR type tokamaks under D/He-3 relevant conditions are considered. Using present scaling laws for beta in the first stability regime, it is found that CIT may be close to breakeven with the presently planned toroidal magnetic field system, if the ASDEX H-mode scaling law is used. With Kaye-Goldston scaling, Q = .22 can be attained, but this requires an excessive amount of RF heating power. Larger devices, such as NET-INTOR, can ignite with ASDEX H-mode scaling with an increase of the toroidal field by 20% and removal of the blanket and reduction of the inboard shield to that required for D/He-3.

42338 **High aspect ratio D-/sup 3/He tokamak reactors.** Deng, B.Q.; Emmert, G.A. (Fusion Technology Institute, Dept. of Nuclear Engineering and Engineering Physics, Univ. of Wisconsin-Madison, 1500 Johnson Drive, Madison, WI (US)). pp 1354-1357 of Proceedings of the 12th symposium on fusion engineering. Piscataway, NJ; IEEE Service Center (1987). (CONF-871007—).

From 12. symposium on fusion engineering; Monterey, CA, USA (12 Oct 1987).

Because of the reduced reactivity of D/He-3 relative to D-T, higher beta operation is necessary with D/He-3. One possibility for high beta is to operate in the second stability regime with a high plasma aspect ratio. The authors investigated some of the physics aspects of second stability, high aspect ratio operation with D/He-3. Ignition may be feasible, depending on the energy confinement scaling, with much reduced plasma current and magnetic field at the TF magnet, in comparison with the corresponding values for low aspect ratio tokamaks operating in the first stability regime.

42339 **Engineering challenges of the plasma diagnostics for CIT.** Lowrance, J.L.; Dudek, L.E.; Young, K.; Ku, L.P. (Princeton Plasma Physics Lab., Princeton Univ., P.O. Box 451, Princeton, NJ (US)). pp 1548-1550 of Proceedings of the 12th symposium on fusion engineering. Piscataway, NJ; IEEE Service Center (1987). (CONF-871007—).

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The ignited plasmas of the current Ignition Torus, CIT, will create a neutron and gamma ray environment that makes instrumenting the machine especially challenging. Table I is a summary of CIT system parameters. The neutron flux corresponding to 300 MW fusion power is — 2 x 10/sup 15/ n sec/sup -1/ cm/sup -2/ at the vacuum vessel wall. The lifetime output of the CIT is approximately 10/sup 24/ neutrons corresponding to a silicon Kerma of — 10/sup 10/ Rad for components inside the vacuum vessel and on port covers. This extraordinary nuclear fusion radiation environment has a major influence on the conceptual design of CIT and the instrumentation needed for plasma diagnostics and machine operation. The CIT concept encloses the fusion machine in an igloo 1.8 meters thick. [The igloo provides — 10/sup 6/ attenuation of the radiation and, equally important, makes possible personnel access to the test cell when the CIT is not operating] CIT access requires receiving igloo sections and the use of remote manipulators inside and outside the vacuum vessel. Plasma diagnostic instrument designs must be amenable with using remote manipulators for maintenance and replacement. The CIT radiation dose rate is approximately 10/sup 6/ Rad sec/sup -1/ at the vacuum vessel ports; exposure for one second equals the rated lifetime dose for radiation hard semiconductors. For this reason the plasma diagnostic concepts rely heavily on optical techniques for sensing the plasma parameters of interest and relaying the data/images to a shielded detector. Optical glass is not sufficiently radiation hard, therefore mirror type optics will be utilized inside the vacuum vessel. Windows will, in most cases, be shielded from direct radiation. New plasma diagnostics are being developed to measure the alpha particles and related DT burn physics.

42340 **Fusion alpha particle diagnostics with gyrotrons.** Woskov, P.P.; Cohn, D.R.; Machuzak, J.S.; Myer, R.C. (Plasma Fusion Center, NW16-134, Massachusetts Institute of Technology, Cambridge, MA (US)). pp 1544-1547 of Proceedings of the 12th symposium on fusion engineering. Piscataway, NJ; IEEE Service Center (1987). (CONF-871007—).

From 12. symposium on fusion engineering; Monterey, CA, USA (12 Oct 1987).

Collective Thomson scattering using long-pulse, millimeter-wave sources is potentially a powerful diagnostic technique of localized alpha particle velocity distribution and density in a fusion tokamak. The Doppler broadened scattered spectrum allows an unambiguous measurement of these parameters. The combination of a long-pulse and long-wavelength source optimizes the achievable signal to noise ratio. Additional advantages include large scattering angles up to 180°, wide-bandwidth receivers, and suitability in a radiation environment. Magnetized particle resonances will be averaged out by finite diagnostic beam divergence and frequency resolution. Millimeter-waves should be accessible to high-field tokamaks using extraordinary mode (x-mode) propagation at frequencies between the lower x-mode cutoff and the upper hybrid resonance.

42341 **MTX plasma diagnostics system.** Rice, B.W.; Hooper, E.B.; Brooksby, C.A. (Lawrence Livermore National Lab., Livermore, CA (US)). pp 1524-1527 of Proceedings of the 12th symposium on fusion engineering. Piscataway, NJ; IEEE Service Center (1987). (CONF-871007—).

From 12. symposium on fusion engineering; Monterey, CA, USA (12 Oct 1987).

The Microwave Tokamak Experiment (MTX) is designed to be a high pulsed-power ECHR plasma heating experiment. The tokamak is the Alcator-C machine which has been moved to LLNL from MIT. This tokamak operates a high-field (9T) and is characterized by high densities, typically 1 - 5 x 10/sup 14/ cm/sup -3/ and electron temperatures > 1 keV. The ECH heating source is a free-electron laser (FEL) which provides a 10 GW peak power at 250 GHz with a 50 ns pulse width and a 5 kHz rep rate. Due to the high-power pulsed FEL heating, the diagnostics system has a unique set of requirements. It is necessary to measure the fast transient plasma heating effects while, at the same time, protecting diagnostics from large levels of stray microwave power. In this paper, a general overview of the MTX plasma diagnostics system is given. This includes a description of the MTX machine configuration and the overall facility layout. The data acquisition system and techniques for diagnostic signal transmission are also discussed. In addition, the diagnostic instruments planned for both an initial ohmic-heating set and a second FEL-heating set are described. The expected range of plasma parameters along with the planned plasma measurements are reviewed.

42342 **Radiation shielding aspects of the TFTR diagnostics.** Liew, S.L.; Ku, L.P. (Plasma Physics Lab., Princeton Univ., Princeton, NJ (US)). pp 1520-1523 of Proceedings of the 12th symposium on fusion engineering. Piscataway, NJ; IEEE Service Center (1987). (CONF-871007—).

From 12. symposium on fusion engineering; Monterey, CA, USA (12 Oct 1987).

To reduce the background noise levels in the numerous diagnostics due to the neutrons and associated γ-rays so that the signal-to-noise ratios are acceptable, properly designed radiation shields are necessary. Considerable experience has been accumulated in designing the shielding for the various diagnostics on TFTR. This paper summarizes the approaches taken in meeting the shielding requirements, with emphasis on the radiation analyses carried out in

support of the designs and comparisons between the calculated noise levels with experimental data where available.

42343 **Plasma fluctuation diagnostic software.** Hong, J.Y.; Powers, E.J.; Ritz, C.P. (Intelligent Signal Processing, Inc., 7719 Wood Hollow Drive, Suite 219, Austin, TX (US)). pp 1508-1511 of Proceedings of the 12th symposium on fusion engineering. Piscataway, NJ; IEEE Service Center (1987). (CONF-871007—).

From 12. symposium on fusion engineering; Monterey, CA, USA (12 Oct 1987).

A software "tool kit", which has been designed for the analysis and interpretation of plasma fluctuation data, is described. In addition, the tool kit contents (partial) and the software design philosophy are presented.

42344 **A compact, multiple fiber-optic bundle viewing system.** Evanko, R.G. (GA Technologies Inc., P.O. Box 85608, San Diego, CA (US)). pp 1504-1507 of Proceedings of the 12th symposium on fusion engineering. Piscataway, NJ; IEEE Service Center (1987). (CONF-871007—).

From 12. symposium on fusion engineering; Monterey, CA, USA (12 Oct 1987).

The details of the design and fabrication of a fiber-optic viewing system are presented. The system was designed for the Thomson scattering profile diagnostic to view discrete plasma points along the line defined by a vertical ruby laser beam inside the vacuum vessel of the DIII-D tokamak. The system is located just outside a vessel port looking through a multiple lens assembly. Fifty-nine fiber-optic bundle locations spaced within a total height of 26.92 cm allow up to 59 discrete plasma points to be observed along a vertical height of 127-152 cm within the vacuum vessel. The essential component of the design is the mechanical mount which holds the viewing end of the fiber bundles. The mount prevents direct handling of the bundles, thus eliminating any damage to the fibers, and allows the bundles to be precisely positioned in any of the 59 locations with relative ease. The use of Computer Aided Design (CAD) and the required precision of the design is discussed.

42345 **Mechanical design considerations for CIT diagnostics.** Dudek, L.E.; Lowrance, J.; Young, K.; Ku, L.P. (Princeton Plasma Physics Lab., Princeton Univ., P.O. Box 451, Princeton, NJ (US)). pp 1492-1495 of Proceedings of the 12th symposium on fusion engineering. Piscataway, NJ; IEEE Service Center (1987). (CONF-871007—).

From 12. symposium on fusion engineering; Monterey, CA, USA (12 Oct 1987).

The Compact Ignition Tokamak (CIT), presently in the conceptual design stage, is being built to study the behavior and characteristics of burning plasmas. The conceptual design for CIT reflects a small 69 inch major radius device. The CIT vacuum vessel has 16 horizontal ports and 64 small vertical access ports located between the toroidal field coils. Approximately half of these ports are dedicated to diagnostic access. The range of plasma parameters has been greatly increased which will require new diagnostic designs. CIT will produce 3 x 10/sup 20/ DT neutrons per pulse causing significant neutron activation of tokamak components, high levels of background noise and neutron radiation damage to conventional materials. To meet this requirement many of the external components are standardized modules which are designed to be removed using the external remote manipulator planned for the test cell. The approach taken for the mechanical design was to create "strawman" layouts of the diagnostics. These drawings were then reviewed with diagnostician and the CIT design integration group for further refinement. Multi-Point Thomson Scattering features a special tangential access view of the plasma to make use of forward scattering from an opposing port. The Grating Polychromator Diagnostic has been designed with the vacuum interface located in a shielded position to reduce the effects of neutron radiation. This paper describes the approach taken to deal with these problems in the conceptual design of the CIT diagnostics.

42346 **Design of a far infrared interferometer diagnostic support structure.** Brooksby, C.A.; Rice, B.; Peebles, W.A. (Lawrence Livermore National Lab., Livermore, CA (US)). pp 1478-1482 of Proceedings of the 12th symposium on fusion engineering. Piscataway, NJ; IEEE Service Center (1987). (CONF-871007—).

From 12. symposium on fusion engineering; 'Monterey, CA, USA (12 Oct 1987).

The Far Infrared Interferometer (FIR) diagnostic will operate in the 119 to 400 micron range to measure the plasma electron density on the Microwave Tokamak Experiment (MTX) being set up at LLNL. This diagnostic is a multi-channel system which incorporates a long elliptically shaped beam that passes through the plasma and is imaged onto an array of 14 detectors that are located on a table above the machine. The reference beam is brought around the machine and mixed with the plasma beam onto the detectors. The density is measured by a phase shift between these beams and is, therefore, very sensitive to path length changes between the two beam paths due to motion of the support structure. The design goal for allowable phase shifts caused by changes in the path length due to structure movement is 1/50th of a wavelength (2.4 to 8 microns). The structure needs to maintain this stability during the 0.5 second plasma shot. The structure is approximately 5 meters tall to support the optics table above the machine. In order to reduce the structure motion to the required level the forces acting on it were evaluated. The forces evaluated were eddy currents from the pulsed electromagnetic fields, the ambient ground motion and the floor movement as the magnets are pulsed. The designs for similar diagnostic interferometers on other tokamaks were also reviewed to evaluate the forces and motions that might cause such small deflections in the support structure. Our structure is somewhat unique in that it is designed for operation in relatively large pulsed magnetic fields (100 to 7000 gauss) arising from the air core transformer of MTX. The design chosen incorporates a very rigid structure with high resistive and non-conductive materials. The choice of materials selected is discussed with references to their response to expected forces.

42347 **Plasma disruption calculations for the TIBER-II design.** Merrill, B.J.; Jardin, S.C. (Idaho National Engineering Lab., EG and G, Idaho Inc., P.O. Box 1625, Idaho Falls, ID (US)). pp 1446-1450 of Proceedings of the 12th symposium on fusion engineering. Piscataway, NJ; IEEE Service Center (1987). (CONF-871007—).

From 12. symposium on fusion engineering; Monterey, CA, USA (12 Oct 1987).

Disruption calculations have been performed with the DSTAR tokamak disruption code at the Idaho National Engineering Laboratory (INEL) for the TIBER-II design study. These calculations are used to determine the effect that an assumed time scale for the thermal quench phase of the disruption has on the calculated plasma current decay rate, the partitioning of the plasma thermal energy, the predicted surface erosion of plasma interface components, and the predicted induced forces in structural components. Since the severity of the disruptive event can be compounded by a vertical instability, the calculations have also been used to consider the case of a disrupting plasma that simultaneously undergoes a vertical instability.

42348 **Theory and simulations on beat-wave excitation or relativistic plasma waves.** Mori, W.B. Los Angeles, CA; Univ. of California (1987). 237p. University Microfilms Order No. 87-19,940.

Thesis (Ph. D.).

Generation of excitation of large-amplitude plasma waves by the beating of two collinear laser beams is studied analytically and via computer experiments. When the difference (beat) frequency of the two lasers is near the natural frequency of the plasma, a large-amplitude wave appropriate for accelerating particles to ultrahigh energies can be excited. Beat-wave excitation is studied analytically in the Eulerian fluid description for prescribed forms of the input light waves. The full set of the Maxwell and plasma-fluid equations is reduced perturbatively to a single cubic nonlinear equation. In the process, a controversy existing over the sign and magnitude of the nonlinear term is resolved. The consistency between the Eulerian and Lagrangian description is explicity verified. Implications of

the reduced equation are studied. The possible competing instabilities are investigated. Relativistic self-modulation and self-focusing of both plasma waves and light waves are discussed in more detail since they are less common in the literature. These competing processes and their importance to VWE are examined through computer experiments. It is found that strongly coupled parametric decay presents the most serious problem for VWE.

42349 **Kinetic studies of thermal relaxation in plasma.** Ko, I.S. Los Angeles, CA; Univ. of California (1987). 112p. University Microfilms Order No. 87-20,012.

Thesis (Ph. D.).

The Lenard-Balescu equation is generalized for a magnetized plasma from the BBGKY hierarchy equation. The random phase approximation and the two time scale approximation are applied along with the neglect of essential 3-particle correlations. The generalized Lenard-Balescu equation is expressed in terms of binary collisions by the screened Coulomb force and the interaction between the individual particle and the collective mode. Weakly unstable cases which can be handled by quasilinear theory are contained in this treatment. The equation is solved numerically for a two-dimensional charged rod plasma with an external uniform magnetic field whose direction is along the charged rod. The thermal relaxation is measured by calculating the entropy of the system. Results are compared and agree qualitatively with ones from particle simulation. The Fokker-Planck equation is also solved numerically for a three-dimensional unmagnetized plasma. The diffusion and the friction coefficients are obtained. A multi-species plasma is studied. For a two-temperature plasma, the lower-speed portion of the hot plasma distribution overshoots, while the cold plasma is still relaxing to a Maxwellian. In both cases the slowing down of the relaxation rate is due to the relaxation times required for the filling of the high-speed tail.

42350 **Hydrodynamic simulation of cold, dense objects evaporating in a hot, tenuous plasma.** Dunning, M.J. Ann Arbor, MI; Univ. of Michigan (1987). 203p. University Microfilms Order No. 87-20,256.

Thesis (Ph. D.).

This subject is of interest to several groups of scientists, including astrophysicists, researchers in magnetic fusion energy (MFE), and researchers in inertial confinement fusion (ICF). Analytic models based on steady-state hydrodynamic conservation equations are routinely used to estimate characteristics of the evaporating material. The author developed a computer code that solves the time-dependent hydrodynamic conservation equations. In the simulations, the code is applied to examine the validity of the steady-state models, and to examine the effect of flux-limited thermal conduction in pellet-injected tokamak plasmas. It was found that the steady-state model examined (Cowie, McKee, Astrophys. J., 211: 135-146, 1977) is reproduced by the time-dependent calculations only when assumptions made by the model are included in the simulations. The most significant assumption is found to be the neglect of the cooling wave launched into the hot plasma as energy is conducted to the cloud. Neglecting the cooling wave results in overestimating the mass ablation rate and underestimating the cloud lifetime. Thus, the applicability of the model is astrophysical and MFE environments is compromised. The cooling wave has less of an effect in ICF experiments since the plasma is steadily reheated by the laser pulse. Evaporation of fuel pellets injected into tokamak plasmas was simulated and results compared to data from experiments.

42351 **Fast waves and electron current drive in the Irvine Torus.** Platt, R.C. Irvine, CA; Univ. of California (1987). 119p. University Microfilms Order No. 87-19,505.

Thesis (Ph. D.).

This work reports the results of experimental studies of the fast wave with frequencies near the mean gyro-frequency in magnetized, toroidal plasmas with comparison to theory. Experiment investigating fast-wave dispersion and damping, and the use of unidirectional fast waves to drive steady-state electron currents were performed on the Irvine Torus. The wave was excited in the plasmas by a phased array antenna which allowed launching of uni- or bi-directional fast waves around the torus. Probe measurements of the angle of propagation of wave energy, radial wavelengths, and the direction and magnitude of radial wave phase velocities were found to be in good agreement with predictions from cold plasma theory. Measurements of fast-wave damping showed the observed damping lengths to be anomalously short when compared to predictions for electron Landau damping, transit-time magnetic pumping, and collisional damping, but may be explained by effects due to fast-wave scattering from drift-wave density fluctuations. Steady-state electron currents were driven by unidirectional fast waves. Up to 14% of the wave energy was converted to poloidal magnetic field energy. The maximum current observed was found to be in rough agreement with a prediction from quasi-linear theory.

42352 **Thomson-scattering plasma diagnosis of the Compact Toroid Transport Experiment (CTTX) using Nd:glass lasers.** Dooling, J.C. University Park, PA; Pennsylvania State Univ. (1987). 271p. University Microfilms Order No. 87-27,999.

Thesis (Ph. D.).

A TEM′ & soo. Nd:glass laser system operating at incident wavelengths of 1053 and 527 nm was used to perform Thomson-scattering diagnosis of compact toroid (CT) plasmas generated within the Compact Toroid Transport Experiment (CTTX). Thomson scattering was employed in order to obtain local plasma measurements necessary for CTTX confinement-physics studies. CT plasmas were created in initial static-fill pressures of 20, 100, and 150 mT of deuterium. Maximum CTTX forward and reversed magnetic-field induction values were 3.5 and 0.9 kG, respectively; the main field was crowbarred with a 1/3 decay time of 36 μs. CT plasmas generated within CTTX were found to have peak densities and temperatures of 2.5 x 10′ & S16. cm′ & S-3. and 20 eV, respectively. Plasma transport was dominated by classical processes in all three pressure cases. Thomson-scattering results were combined with data from other diagnostics; these included diamagnetic and magnetic field probes, a high-speed, image-converter camera, and a Mach-Zender interferometer. Combined diagnostic results corroborated CT behavior such as axial contraction after field-line reconnection.

42353 **Production and study of a collisionless trapped-particle instability.** Scarmozzino, R. New York, NY; Columbia Univ. (1987). 112p. University Microfilms Order No. 87-24,089.

Thesis (Ph. D.).

The Columbia Linear Machine was redesigned to enter the parameter regime of the collisionless, curvature-driven, trapped-particle instability. The neutral pumping system was improved. Density-reduction grids were employed to lower the plasma density in the experimental region without affecting the plasma source operation. The mirror cell length was reduced to a minimum to raise the bounce-averaged bad magnetic curvature. An RF heating system was installed that raised the parallel electron and ion temperatures by a factor of two, the perpendicular ion temperature by an order of magnitude, and the trapped fraction by over a factor of two. These changes reduced the neutral collisionality by over a factor of two and the Coulomb collisionality by an order of magnitude, and increased the curvature drive by nearly an order of magnitude. A theory developed describes the mode in the presence of a DC radial electric field. The observed real frequency is in reasonable agreement with the prediction of this theory. The theory also indicates that the drive for the mode has a rotational component in addition to the curvature drive.

42354 **Magnetic surfaces and neoclassical transport in stellarators.** Ng, K.C. New York, NY; New York Univ. (1987). 139p. University Microfilms Order No. 87-22,777.

Thesis (Ph. D.).

The structure of a stellarator field and confinement of a high-temperature plasma in toroidal geometry are studied. A field-line tracing program is developed to explore the structure of magnetic fields on a fine scale so as to explain anomalous electron transport. The model magnetic field chosen has a simple analytic representation easy to compute, so that one can integrate the field lines to a high accuracy. On the CRAY computer, integration over one field period requires only 30 μs. In a typical case most of the magnetic surfaces are well behaved on the scale of the gyroradius of the electron. Results suggest that the anomalous electron transport observed in experiments may be due to the presence of an ambipo-

lar electrostatic potential Phi. This hypothesis is investigated by computing the guiding-center orbits of the electrons and estimating island widths of the drift surfaces that are swept out. Numerical results confirm that resonance of the electric potential Phi at the rational magnetic surfaces may cause anomalous electron transport. The conclusion is substantiated by a calculation of the confinement time using the Monte Carlo method.

42355 **RF startup in the Phaedrus and Phaedrus-B tandem mirrors.** Goulding, R.H. Madison, WI; Univ. of Wisconsin (1987). 264p. University Microfilms Order No. 87-19,101.

Thesis (Ph. D.).

A new method for producing plasma buildup in a tandem mirror was developed. A cold (T/sub c/ $\leqq$ 12eV), low-density (n $\leqq 4 \times 10^{11}$ cm^{-3}) plasma was produced initially in the central cell, using ECH to break down neutral gas puffed in through a gas box located at the cell midplane. The plasma density and energy were then built up using ICRF heating, with final densities as high as 10^{13} cm^{-3} being achieved by this method. The technique was successfully employed for buildup of plasma columns stabilized with minimum-[B] anchors as well as plasma columns stabilized by ponderomotive force generated by the ICRF. The plasma buildup under the influence of the ICRF heating was investigated. It was found that direct electron heating by the ICRF played a crucial role. It was also determined that ECH-generated hot electrons were not required for successful plasma buildup. An important finding was that the buildup was inhibited or totally prevented when the initial electron temperature was too low. This condition occurred at high neutral pressure levels, or low ECH power levels. The STARTUP point code was created to model the ICRF-induced plasma buildup.

42356 **Magnetic-field structure of experimental high-beta tokamak equilibria.** Deniz, A.V. Columbia, NY; Columbia University (1986). vp.

The magnetic field structure of several low- and high-β tokamaks in the Columbia High Beta Tokamak (HBT) was determined by high-impedance internal magnetic probes. From the measurement of the magnetic field, the poloidal flux, toroidal flux, toroidal current, and safety factor are calculated. In addition, the plasma position and cross-sectional shape are determined. The extent of the perturbation of the plasma by the probe was investigated and was found to be acceptably small. The tokamaks have major radii of $\sim$ 0.24 m., minor radii of $\sim$ 0.05 m., toroidal plasma current densities of $\sim 10^6$ A/m^2, and line-integrated electron densities of $\sim 10^{20}$ m^{-2}. The major difference between the low- and high-β tokamaks is that the high-β tokamak was observed to have an outward shift in major radius of both the magnetic center and peak of the toroidal current density. The magnetic center moves inward in major radius after 20 to 30 μsec, presumably because the plasma maintains major radial equilibrium as its pressure decreases from radiation due to impurity atoms. Both the equilibrium and the production of these tokamaks from a toroidal field stabilized z-pinch are modeled computationally. One tokamak evolves from a state with low-β features, through a possibly unstable state, to a state with high-β features.

42357 **Energy recovery from a space-charge neutralized positive ion beam by means of magnetic electron suppression.** Ryan, P.M. Knoxville, TN; Univ. of Tennessee (1986). 182p. University Microfilms Order No. 87-615 4000.

Thesis (Ph. D.).

The charge-exchange neutralization efficiency of positive-ion-based neutral beams used in plasma-heating applications decreases as the beam energy increases. Direct energy recovery from the charged particles can be accomplished by electrostatically decelerating the positive ions; the problem is to effect this without accelerating the space-charge-neutralizing electrons residing in the beam. Prior work with both electrostatic and magnetic electron suppression is reviewed. A finite-difference ion-optics code which solves the nonlinear Vlasov-Poisson equation is adapted to energy-recovery application and used to analyze the transverse magnetic field electron suppression experiments carried out at Oak Ridge National Laboratory between 1980 and 1982. Three numerical models are discussed and evaluated. The double-plasma model, which assumes an equilibrium Boltzmann distribution of electrons at both the neutralizer potential and the ion-collector potential, most successfully duplicates the experimental results with beams in the 40-keV, 10-A range. It is used to analyze the effects of the magnetic-field strength, the ion boost energy, and the ion-beam current density on the ion-collection efficiency. Conclusions of the study are discussed briefly.

42358 **Contributions to the muon catalyzed fusion workshop.** Idaho Falls, ID; Idaho National Engineering Lab. (1985). 348p. (CONF-840660—). Idaho National Engineering Lab., P.O. Box 1625, Idaho Falls, ID 83415.

From Workshop on muon-catalyzed fusion reactions; Jackson, WY, USA (7 Jun 1984).

This book contain topics covered in the muon-catalyzed fusion workshop at Idaho National Engineering Laboratory, and include discussion on the slpha sticking fraction; temperature dependence of the hyperfine quenching rate; mesic molecule formation rates and resonance models; efficient methods of muon production; and recovery of energy from protons and neutrons following pion production.

42359 **Development of target capsules for muon-catalyzed fusion experiments.** Watts, K.D.; Jones, S.E.; Caffrey, A.J. (EG and G Idaho, Inc. (US)). pp 7 of Contributions to the muon catalyzed fusion workshop. Idaho Falls, ID; Idaho National Engineering Lab. (1985). (CONF-840660—).

From Workshop on muon-catalyzed fusion reactions; Jackson, WY, USA (7 Jun 1984).

A series of Muon-Catalyzed Fusion experiments has been conducted at the Los Alamos Meson Physics Facility to determine how many fusion reactions one muon would catalyze under various conditions of temperature, pressure, contamination, and tritium concentration. Target capsules to contain deuterium and tritium at elevated temperatures and pressures were engineered for a maximum temperature of 540 K (512°F) and a maximum pressure of 103MPa (15,000 psig). Experimental data collected with these capsules indicated that the number of fusion reactions per muon continued to increase with temperature up to the 540-K design limit. Theory had indicated that the reaction rate should peak at approximately 540K, but his was not confirmed during the experiments. A second generation of capsules which have a maximum design temperature of 800 K (980°F) and a maximum design pressure of 103MPa (15,000 psig) has now been engineered and used in experiments.

42360 **Muon catalysis rates in high density dt mixtures.** Anderson, A.N.; Jones, S.E.; Walter, J.B.; Watts, K.D.; Bradbury, J.N.; Gram, P.A.M.; Leon, M. (Idaho National Engineering Lab. (US)). pp 7 of Contributions to the muon catalyzed fusion workshop. Idaho Falls, ID; Idaho National Engineering Lab. (1985). (CONF-840660—).

From Workshop on muon-catalyzed fusion reactions; Jackson, WY, USA (7 Jun 1984).

The temperature dependence of muon-catalyzed d-t fusion in the range 100 to 540K was reported earlier. The authors now extended the measurements down to 27K (d-t liquid) and up to 800K. Resonant dtμ-molecular formation rates for D/sub 2/ and DT target molecules differ greatly over the extended temperature range.

42361 **New results regarding the α-sticking fraction in muon-catalyzed d-t fusion.** Caffrey; Anderson, A.N.; Jones, S.E.; Walter, J.B.; Watts, K.D.; Bradbury, J.N.; Gram, P.A.M.; Leon, M.; Maltrud, H.R.; Paciotti, M.A. (Idaho National Lab. (US)). pp 7 of Contributions to the muon catalyzed fusion workshop. Idaho Falls, ID; Idaho National Engineering Lab. (1985). (CONF-840660—).

From Workshop on muon-catalyzed fusion reactions; Jackson, WY, USA (7 Jun 1984).

In initial investigations of muon-catalyzed fusion in high-density deuterium-tritium mixtures, the authors demonstrated that the resonant dtμ-molecular formation rates were 3 orders of magnitude larger than muon decay rates. They also measured for the first time the α-sticking fraction (muon retention by the fusion α product). The authors concluded that the α-sticking fraction, not the dtμ-molecular formation rate, was the principle limiting factor to muon-catalyzed fusion. They now measured effects of ttμ-fusion, permit-

ting an important correction to earlier determination of the α-sticking probability. Furthermore, new results show that the α-sticking fraction decreases significantly with increasing d-t gas density and tritium concentration.

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REFER ALSO TO CITATION(S) 39273, 39438, 40813, 40967, 41736, 42125, 42233, 42259, 42271, 42272, 42321, 42330, 42331, 42350, 42359

42362 **(AD-A—190463/0/XAB) Investigation of laser-induced plasma processes. Scientific report No. 14, 14 March-30 December 1986.** Ip, P.C.; Armstrong, R.A.; Baird, J.C. (Visidyne, Inc., Burlington, MA (USA)). 30 Dec 1986. 91p. NTIS, PC A05/MF A01.

Preliminary results on the hydrodynamics and Stark calculations of the AFGL-LINUS plasma are presented. Also reported is a kinetic analysis based on the most-recent spectroscopic temperatures. Various calculations of different aspects of the LINUS plasma are shown. Finally, the codes (EXCEDE/ARTIC) that have potential applications to LABCEDE are discussed.

42363 **(CEA-CONF—9191) Experimental and simulated impurity line radiances during ECR heating and pellet injection on TFR.** Saoutic, B. (Association Euratom-CEA, Centre d'Etudes Nucleaires de Cadarache, 13 - Saint-Paul-lez-Durance (France). Dept. de Recherches sur la Fusion Controlee). 1987. 4p. (CONF-870629—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88753895/JAW.

From 14. European conference on controlled fusion and plasma physics; Madrid, Spain (22 Jun 1987).

Electron cyclotron resonance heating (ECRH) experiments on the TFR Tokamak have been previously described. There like in most of the papers published on ECRH experiments, impurity behaviour studies have been rather neglected, probably as a consequence of the relatively small increment of radiated power (measured by bolometry) during ECRH. In this section, after a brief description of the plasma parameters and of the methodology used for simulations, we shall report the results of detailed comparisons between experiments and simulations for central heating of plasmas with two different n/sub e/ values. The contribution of impurities to energy balance (radiated power) and to effective charge z/sub eff/ will be evaluated.

42364 **(CEA-CONF—9194) Specific micro fluctuations associated with sawtooth relaxation.** Truc, A.; Gresillon, D. (Ecole Polytechnique, 91 - Palaiseau (France). Lab. de Physique des Milieux Ionises). 1987. 4p. (CONF-870629—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88753898/JAW.

From 14. European conference on controlled fusion and plasma physics; Madrid, Spain (22 Jun 1987).

We observe in the TFR tokamak bursts of density fluctuations localized in space and time, synchronously with the sawtooth disruptions of the plasma.

42365 **(CEA-CONF—9195) Pellet injection experiments on the TFR tokamak.** Drawin, H.W. (Association Euratom-CEA, Centre d'Etudes Nucleaires de Cadarache, 13 - Saint-Paul-lez-Durance (France). Dept. de Recherches sur la Fusion Controlee). 1987. 4p. (CONF-870629—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88753899/JAW.

From 14. European conference on controlled fusion and plasma physics; Madrid, Spain (22 Jun 1987).

The essential results of the pellet injection experiments carried out on the TFR Tokamak from 1983 until the shut-down of the machine in June 1986, are summarized. Hydrogen and deuterium pellets, occasionally doped with neon, were injected into ohmically and also additionally NB and ECR heated plasmas. Direct observation of the pellet trajectories yields insight in the properties of the ablation clouds. Measurements of the bulk plasma show a rapid temperature evolution during and just after the ablation process. The electron density changes radially on a much longer time scale. Transport simulations in particular for multi-pellet injection leads to the conclusion that the transport coefficients for the density transport are not drastically modified during the density relaxation phase.

42366 **(CEA-CONF—9196) Hydrogen and deuterium pellet injection into ohmically and additionally ECR-heated TFR plasmas.** Drawin, H.W. (Association Euratom-CEA, Centre d'Etudes Nucleaires de Cadarache, 13 - Saint-Paul-lez-Durance (France). Dept. de Recherches sur la Fusion Controlee). 1987. 4p. (CONF-870629—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88753900/JAW.

From 14. European conference on controlled fusion and plasma physics; Madrid, Spain (22 Jun 1987).

The ablation clouds of hydrogen and deuterium pellets injected into ohmically and electron cyclotron resonance heated (ECRH) plasmas of the Fontenay-aux-Roses tokamak TFR have been photographed, their emission has been measured photoelectrically. Without ECRH the pellets penetrate deeply into the plasma, the clouds are striated. Injection during ECRH leads to ablation in the outer plasma region. The position of the ECR layer has no influence on the penetration depth which is only a few centimeters. The ablation clouds show no particular structure when ECRH is applied.

42367 **(CNIC—00036) Neutronics design for a fusion breeder.** You Chenglun; Xie Zhongyou. (China Nuclear Information Centre, Beijing, BJ). 1987. 8p. (In Chinese). (SIP—0015). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702629/JAW.

As a fusion breeder, one of the most important figure is support ratio which reflects the economic and fuel production performance of the system to a great extent. In this paper, the support ratio is calculated by using one dimension transport program ANISN and optimized by adjusting /sup 6/Li enrichment and blanket arrangement. The radial distribution of producted U-233 is also taken into account. Measures are taken for better blanket design, and satisfactory results are obtained. Tritium breeding ratio T reaches 1.11 and the support ratio is enhanced from 11 to 14. The engineering, safety and environment performance are improved.

42368 **(CONF-880613—7) Radiation damage calculations for compound materials.** Greenwood, L.R. (Argonne National Lab., IL (USA)). 1988. Contract W-31109-ENG-38. 19p. (CONF-880613—). NTIS, PC A03/MF A01; GPO Dep. Order Number DE88009933/JAW.

From 14. international symposium on effects of radiation on materials; Andover, MA, USA (27 Jun 1988).

The SPECOMP computer code has been developed to calculate neutron-induced displacement damage cross sections for compound materials, such as alloys, insulators, and ceramic tritium breeders for fusion reactors. These new calculations rely on recoil atom energy distributions previously computed with the DISCS computer code, the results of which are stored in our SPECTER computer code master libraries. All reaction channels were considered in the DISCS calculations and the neutron cross sections were taken from ENDF/B-V. Compound damage calculations with SPECOMP thus do not need to perform any recoil atom calculations and consequently need no access to ENDF or other neutron data bases. The calculations proceed by determining secondary displacements for each combination of recoil atom and matrix atom, using the Lindhard partition of the recoil energy to establish the damage energy. A separate average displacement threshold energy is assigned to each atom in the compound. Calculations have been completed for stainless steel, vanadium alloys, ^{6}Li-compound tritium breeders, alumina, SiO_2,Cu_3Au, TaO, and NbTi superconducters. Cross sections are now being developed for other compounds; however, some research is needed to determine the proper threshold energies for many compounds. All of these energy-dependent cross sections have been added to the SPECTER computer code, thus permitting routine spectral-averaging of each dpa cross section for any specified neutron spectrum up to 20 MeV. Calculations can be readily performed for any combination of the 38 elements in SPECTER. The new compound dpa cross sections are compared to atom-weighted results using elemental dpa values. Large differences are noted in cases where there are substantial

mass and damage threshold energy differences between the elements. However, the compound dpa effects are quite small for structural materials such as stainless steel. 11 refs., 4 figs., 1 tab.

42369 **(DOE/ER—0313/3) Fusion reactor materials: Semiannual progress report for period ending September 30, 1987.** (Oak Ridge National Lab., TN (USA)). Mar 1988. Contract AC05-84OR21400. 309p. (ORNL/M—514). NTIS, PC A14/MF A01;1; GPO Dep. Order Number DE88010769/JAW.

This is the third in a series of semiannual technical progress reports on fusion reactor materials. This report combines research and development activities which were previously reported separately in the following technical progress reports: Alloy Development for Irradiation Performances; Damage Analysis and Fundamental Studies; Special Purpose Materials. These activities are concerned principally with the effects of the neutronic and chemical environment on the properties and performance of reactor materials; together they form one element of the overall materials program being conducted in support of the Magnetic Fusion Energy Program of the US Department of Energy. The other major element of the program is concerned with the interactions between reactor materials and the plasma and is reported separately. The Fusion Reactor Materials Program is a national effort involving several national laboratories, universities, and industries. The purpose of this series of reports is to provide a working technical record for the use of the program participants, and to provide a means of communicating the efforts of materials scientists to the rest of the fusion community, both nationally and worldwide.

42370 **(DOE/ER/53091—3) Collisional mechanisms in D/sup {minus}/ beam sources for MFE experiments and reactors: Final technical report covering period 2 January 1980-30 June 1986.** Coggiola, M.J.; Peterson, J.R. (USDOE, Washington, DC; SRI International, Menlo Park, CA (USA)). Apr 1987. Contract AT03-80ER53091. 49p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88011642/JAW.

This final report reviews the entire technical effort by SRI International under contract AT03-80ER53091 for the period January 2, 1980 through June 30, 1986. The primary goal of this research effort was to provide a clearer understanding of the basic atomic physics processes underlying the formation of negative ion beams for use in MFE experiments and reactors. The three major topics covered during the course of this work are described and discussed in detail: angular scattering effects in double electron capture formation of H/sup {minus}//D/sup {minus}/ beams; negative ion formation from low-work function surfaces; product state determination in electron capture reactions. The detailed discussions rely largely on relevant technical publications that have been produced during the performance of this contract. 17 figs.

42371 **(DOE/ET/51013—224) Safety and economic comparison of fusion fuel cycles.** Brereton, S.J.; Kazimi, M.S. (Massachusetts Inst. of Tech., Cambridge (USA)). Aug 1987. Contract AC02-78ET51013;AC07-76ID01570. 712p. (PFC/RR—87-7). NTIS, PC A99/MF A01;1; GPO Dep. Order Number DE88009202/JAW.

The DT, DD and DHe fusion fuel cycles are compared on the basis of safety and economics. The designs for the comparison employ HT-9 structure and helium coolant; liquid lithium is used as the tritium breeder for the DT fuel cycle. The reactors are pulsed superconducting tokamaks, producing 4000 MW thermal power. The DT and DD designs are developed utilizing a plasma beta of 5%, 10% and 20%, assuming first stability scaling laws; a single value of 10% for beta is used for the DHe design. Modest extrapolations of current day technology are employed, providing a reference point for the relative ranking of the fuel cycles. Technological advances and improved understanding of the physics involved may alter the relative positions from what has been determined here. 92 figs., 59 tabs.

42372 **(ENEA-RT-FUS—87-26) Contributions to the X National Congress on vacuum science and technology. Stresa 12-17 October 1987.** Ferro, A.; Maddaluno, G.; Ciotti, M.; Alessandrini, C.; Apicella, M.L. (ENEA, Rome (Italy)). 1988. 37p. (CONF-8710333—). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702847/JAW.

From 10. national congress on vacuum science and technology; Stresa, Italy (12 Oct 1987).

Three papers presented by ENEA searchers at the Tenth National Congress on vacuum science and technology are contained. They deals with the vacuum system, first wall technology and limiter problems in Frascati Tokamak Upgraded.

42373 (ENEA-RT-FUS—87-26, pp 17-26) **Plasma limiter interaction in the FT machine.** Ferro, C.; Maddaluno, G.; Ciotti, M. (ENEA, Frascati (Italy). Centro Ricerche Energia). 1988. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702847/JAW. (CONF-8710333—).

From 10. national congress on vacuum science and technology; Stresa, Italy (12 Oct 1987).

In a tokamak with limiter-controlled discharges, a careful analysis of the thermal load to the limiter is necessary in oreder to optimize the choice of the surface shape and the material to be used in forthcoming machines. A set of thermocouples embedded within the full poloidal limiter of FT (Frascati Torus) was used together with a finite difference heat conduction code to get both the amount and the spatial profile of the power lost to the limiter during ohmic discharges. The method is briefly discussed and the data collected during the April/May 1986 experimental period are reported.

42374 (ENEA-RT-FUS—87-26, pp 5-16) **Vacuum problems and first wall technologies in the FTU machine.** Ferro, C. (ENEA, Frascati (Italy). Centro Ricerche Energia). 1988. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702847/JAW. (CONF-8710333—).

From 10. national congress on vacuum science and technology; Stresa, Italy (12 Oct 1987).

FTU (Frascati Tokamak Upgraded) in a high field compact tokamak which is presently under construction at the ENEA-CRE Frascati. Its main objective is to produce high density, high temperature plasmas with long energy confinement time to study reactor relevant regimes. One of the consequences of the operating regime in a high power flux to the vacuum chamber. In this paper are presented the machine and the solution adopted in realizing the vacuum chamber and the vacuum system.

42375 (ENEA-RT-FUS—87-26, pp 27-37) **Vacuum system and cleaning techniques in the FTU machines.** Alessandrini, C.; Apicella, M.L.; Ferro, C. (ENEA, Frascati (Italy). Centro Ricerche Energia). 1988. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702847/JAW. (CONF-8710333—).

From 10. national congress on vacuum science and technology; Stresa, Italy (12 Oct 1987).

FTU (Frascati Tokamak Upgrade) is a high magnetic field (8T) tokamak under construction at the Frascati Energy Research Center (ENEA). Its vacuum systems has been already manifactured and is presently being assembled. It consist of an all metallic fully welded vessel, pumped by six turbomolecular pumps. The vacuum system has been dimensioned to allow a base pressure lower than 2.6 x 10/sup -6/Pa. The paper reports the design philosophy of the vacuum system. The results of the cleaning techniques performed on a 1:1 scale toroidal sector of FTU are also presented and discussed.

42376 **(ENEA-RT-TIB—87-29) ENEA contribution to BEATRIX/FUBR-1B experiment. High burnup under fast neutrons irradiation of Lithium ceramics.** Alvani, C.; Casadio, S.; Ciavola, C.; Dibartolomeo, A.; Martelli, S.; Pierdominici, F.; Vittori, M.; Brambilla, G. (ENEA, Rome (Italy)). 1987. 13p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88701563/JAW.

The preparation and characterization is reported for the gamma-LiA102 specimens (prepared by the ENEA) for the long

term (2 FPY), high Li-6 burnup and thermal gradients in fast neutron (EBR-II) irradiation. The work was performed in the frame of the international BEATRIX programme.

42377 (IAEA-TECDOC—440, pp 13-29) **Canadian activities on safety and environmental aspects of fusion.** Wong, K.Y.; Burnham, C.D.; Stasko, R.R.; Smith, S.M. (Canadian Fusion Fuels Technology Project, Mississauga, Ontario (Canada)). Dec 1987. NTIS (US Sales Only), PC A16/MF A01. Order Number DE88702856/JAW. (CONF-861143—).

From IAEA technical committee meeting on fusion reactor safety; Culham, UK (3 Nov 1986).

Canadian fusion safety related activities addresses key safety issues in the design and operation of fusion facilities with emphasis on: (1) Tritium hazard assessment and control; (2) Remote handling and fusion reactor maintenance; (3) Environmental impact assessment. Ongoing R and D addresses tritium permeation, retention, permeation barriers, tritium protective coatings, and conversion of gaseous tritium to oxide. Tritium dosimetry research addresses the in vivo oxidation of inhaled tritium gas to oxide and skin uptake and dosimetry from contact with tritium contaminated metal surfaces. Tritium monitors are developed to discriminate between gaseous and oxide forms of tritium and to address problems in fusion reactor environments due mainly to the presence of gamma fields and other radioactive gases. CANDU tritium control technologies are reviewed. Safety-related contributions to design studies such as INTOR and MINIMARS have helped to confirm that the bulk of maintenance work in the reactor hall will require remote handling. Canadians have also participated in the design of remote handling systems at TFTR, JET and NET. Environmental research focuses on the conversion of gaseous tritium to oxide and development of computer codes for tritium impact assessment. A computer code, called OHTDC, was developed to model the dispersion and transport of both gaseous and oxide forms of tritium. The code uses finite element methods and allows for the environmental conversion of gaseous tritium to oxide as well as resuspension of tritium oxide from ground to air. Experimental data obtained under controlled field and laboratory conditions showed that the conversion of tritium gas to oxide in the terrestrial environment is a relatively slow process mediated predominantly by soil microbial organisms with negligible direct uptake of tritium gas by foliage.

42378 (IC—87/256) **Ion beam driven expansion of super-range multilayer plane targets.** Piriz, A.R. (International Centre for Theoretical Physics, Trieste (Italy)). Aug 1987. 15p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702972/JAW.

The expansion of a multilayer plane target driven by an ion beam which has a range shorter than the thickness of the slab is described by means of a simple analytic model. The effect of a two-layer structure is studied and criteria for the optimization of the kinetic energy of the unheated part of the slab, the payload, are set. (author). 14 refs, 3 figs.

42379 (INIS-mf—11271) **Canadian Fusion Fuels Technology Project activities report, 1984-1985.** (Canadian Fusion Fuels Technology Project, Toronto, Ontario). 1985. 44p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703275/JAW.

The Canadian Fusion Fuels Technology Project was formally established in 1982. The project is directed toward the further development of Canadian capabilities in five major areas: tritium technology, breeder technology, materials technology, equipment development and safety and the environment. The project is funded by three partners - Government of Canada (50%), Ontario Provincial Government (25%) and Ontario Hydro (25%). The fiscal year 1984/85 represents the third year of operation of the project. In 1984/85, 108 contracts were awarded totalling $4 million. Supplementary funding by subcontractors added approximately $1.9 million to the total project value. More than 200 people participated in the technical work involved in the project. Sixteen people were on attachment to foreign facilities for terms ranging from 1 month to 2.5 years. Five patents were applied for including a tritium discrimination monitor, a new radio-chemical tritium separation method, a new variation of fuel cleanup by gas chromatography, a passive tritium permeation system using bimetallic membranes, and a new breeder process using lithium salts dissolved in heavy water.

42380 (INIS-SU—31/A) **Powerful wide-range dye laser with improved space-angular characteristics pumped by tubular lamps.** Korobov, A.M.; Nikolaev, S.V. (AN Ukrainskoj SSR, Kharkov. Inst. Radiofiziki i Ehlektroniki). 1986. 32p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703282/JAW.

Preprint--300.

Sustantiation of a choice of a circular cell construction for creation of power widerange dye laser (DL) is described. In the DL with a circular cell pumped by a block of self-powered linear pulse lamps it is obtained radiation in the range 460 ... 660 nm with energy from 11.5 to 50 j at power 2.4 ... 10 MW. A dynamic of formation of a beam pattern of the DL with a circular cell has been studied. Different methods of suppression of non-axial beams are suggested and tested, among them such method as a pumping of the cell from inside allowing to reduce radiation divergence in more than 20 times.

42381 (IPP—2/289) **Analysis of ICRF wave heating in the Wendelstein VII-AS stellarator.** Itoh, K.; Itoh, S.I.; Fukuyama, A.; Noterdaeme, J.M.; Wobig, H. (Kyoto Univ., Uji (Japan). Plasma Physics Lab.; Hiroshima Univ. (Japan). Inst. of Fusion Theory; Okayama Univ. (Japan). School of Engineering). (Max-Planck-Institut fuer Plasmaphysik, Garching (Germany, F.R.); Kyoto Univ., Uji (Japan). Plasma Physics Lab.; Hiroshima Univ. (Japan). Inst. for Fusion Theory; Okayama Univ. (Japan). School of Engineering). Sep 1987. 28p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88753818/JAW.

The propagation and absorption of the ICRF (ion cyclotron range of frequencies) waves in the Wendelstein VII-AS stellarator is studies. Both the cases of the two-ion hybrid resonance heating and second harmonic cyclotron resonance heating are investigated by solving the global wave equation. Accessibility range and antenna loading impedance for various plasma parameters as well as the power deposition profile are obtained. The generation of fast ions is also discussed. (orig.)

42382 (IPP—III/120, pp 3-6) **Pellet injection with improved confinement in ASDEX.** Mertens, V.; Kaufmann, M.; Buechl, K.; Fussmann, G.; Gehre, O.; Grassie, K.; Gruber, O.; Haas, G.; Janeschitz, G.; Kornherr, M. Jun 1987. NTIS (US Sales Only), PC A07/MF A01. Order Number DE88753822/JAW. (CONF-870629—).

From 14. European conference on controlled fusion and plasma physics; Madrid, Spain (22 Jun 1987).

An intensive campaign to study the consequences of repetitive pellet injection was carried out on ASDEX. It was possible to improve by pellet injection considerably the plasma confinement compared to earlier investigations. In addition we could advance considerably the understanding of the relevant mechanisms. The dominant difference between the earlier and the recent experiments was different recycling in the plasma boundary and the divertor. While the earlier campaign aimed at low-recycling pellet injection (LRP) to study the genuine pellet fuelling, the second campaign aimed at an improvement of the density limit. (orig.)

42383 (IPPJ—853) **Optimization of volume produced H/sup -/ ions in a low-pressure hydrogen plasma.** Fukumasa, Osamu; Saeki, Setsuo; Shiratake, Shigeru. (Nagoya Univ. (Japan). Inst. of Plasma Physics). Nov 1987. 43p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88754103/JAW.

Optimization of volume produced H/sup -/ ions is studied by using a set of particle balance equations in a steady state hydrogen plasma with a single chamber system. Dependences of both H/sup -/ and vibrationally excited hydrogen molecules H/sub 2/* productions on plasma parameters (i.e. electron temperature T/sub e/, hydrogen gas pressure p, electron density n/sub e/, density ratio n/sub fe//n/sub e/ of fast electron e/sub f/ to cold plasma electron e, energy of fast electron E/sub fe/) are explored because H/sup -/ ions are generated by the following two-step process, i.e. H/sub 2/ + e/sub f/ -> H/sub 2/* + e/sub f/ ; H/sub 2/* + e -> H/sup -/ + H. Particular attention is also paid to wall effects on H/sup -/ production. The wall recombination coefficient γ/sub 1/

for H and the wall de-excitation collision parameter γ/sub 2/ are treated as numerical parameters. It is confirmed that the presence of e/sub f/ with energies in excess of 40 eV is essential to H/sup -/ production. With increasing T/sub e/ (above 1 eV), H/sup -/ yield decreases monotonically. n/sub e/, n/sub fe//n/sub e/ and p have some optimum values for H/sup -/ production. These plasma parameter dependences for H/sup -/ ions, namely optimum conditions, are not compatible with those for H/sub 2/* formation. Another significant point is that ion species ratios depend strongly on wall parameters, i.e. γ/sub 1/ and γ/sub 2/. For H/sup -/ production, the optimum condition is that γ/sub 1/ ≃ 1 and γ/sub 2/ << 1.

42384 **(JAERI-M—87-208) Design of millimeter-wave components at 120 GHz for electron cyclotron heating.** Goto, Masaharu; Sakamoto, Keishi; Nagashima, Takashi. (Japan Atomic Energy Research Inst., Tokyo). Jan 1988. 42p. (In Japanese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88753616/JAW.

As a part of developments on microwave circuits for electron cyclotron heating on large tokamaks, a TE/sub 01/-TE/sub 04/ mode converter (120 GHz) and a TE/sub 04/ mode directional coupler (120 GHz) are designed. Mode distribution in the mode converter is determined by solving the generalized telegraphist's equations. The mode conversion ratio is more than 96 %. The TE/sub 04/ mode directional coupler is a multi hole type one and coupling coefficient of 38 dB, the directivity of more than 60 dB, and the mode selectivities of more than about 15 dB except TE/sub 24/ mode are obtained.

42385 **(JAERI-M—87-209) Neutral beam current drive for INTOR, the potential in steady state and quasi steady state operations.** Okano, Kunihiko; Yamamoto, Shin; Sugihara, Masayoshi; Fujisawa, Noboru. (Japan Atomic Energy Research Inst., Tokyo). Jan 1988. 49p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88753617/JAW.

The neutral beam current drive potential was investigated for INTOR benchmark test parameters. Various parameter dependences for the current drive efficiency were calculated and the 500 keV beam feasibility in INTOR design was clarified. The calculation includes spatial distributions for the beam driven currents. A flexible current profile control ability has been confirmed. It was also revealed that the same beam system could be used for strict steady state operation and for transformer recharging in quasi-steady state scenarios.

42386 **(JAERI-M—87-211) RF heating and current drive experiments on JT-60.** Uehara, Kazuya; Ikeda, Yoshitaka; Saigusa, Mikio . (Japan Atomic Energy Research Inst., Tokyo). Jan 1988. 26p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88753618/JAW.

Recent experimental results of Lower Hubrid and Ion Cyclotron Range of Frequencies (LHRF and ICRF) heating and current drive are presented on JT-60 at JAERI. About 24 MW LHRF at 2 GHz and 6 MW ICRF at 120 MHz system are installed in JT-60. LHRF has launched 11.0 MW and ICRF has launched 2.1 MW of rf power into the JT-60 plasma through the sufficient aging process of the power injection into the TDC plasma and/or the vacuum chamber keeping 150 deg C baking of the launcher. Effective electron heating is performed with LHRF and with the combination of NBI and LHRF. Steady current drive of 2 MA for 2.5 sec and the current drive efficiency of eta/sub CD/ = (1.5 - 3.0) x 10/sup 19/ m/sup -2/ AW/sup -1/ are obtained with and without NBI. Current ramp-up saves the volt center dot sec of OH transformer, which supports the high plasma current formation of 3.25 MA. Improvement of the plasma confinement at the low density region in LHCD is discussed including the pinch effect. Optimization of 2 ω/sub ci/ ICRF heating is studied with 2 x 2 phased loop antenna. Effective matching technique using movable stub tuner with high speed enable to quicken the aging process of ICRF power injection in JT-60 plasma. The phasing of (π,0) of the loop antenna brings an effective power deposition into plasmas and the beam accelaration of NBI by ICRF wave was observed although the coupling resistance is relatively lower than the one of (0,0) mode. The beam acceleration causes the relatively higher incremental energy confinement time of more than 200 msec, which is explained by the slowing down process of the accelerated ion tail.

42387 **(JAERI-M—87-216) Considerations of device and operational flexibility in FER.** Sugihara, Masayoshi; Miki, Nobuharu; Nishio, Satoshi; Yamada, Masao; Yamamoto, Shin. (Japan Atomic Energy Research Inst., Tokyo). Jan 1988. 27p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88753620/JAW.

Expected physics uncertainties in DT burning plasma of FER, which may not be removed completely at the start of construction or DT operation, are reviewed. Several possible device and operational flexibility scenarios to cope with these uncertainties are considered. They are (1) Plasma size enlargement scenario, (2) Plasma shape flexibility scenario, (3) Heating/Current drive/Control system flexibility scenario, (4) Impurity control system flexibility scenario and (5) Advanced operation scenario. Feasibility of these flexibility scenarios are examined and shown to be practicable. However, careful assessment of the physics data base is necessary at the start of construction and DT operation to proceed to actually implement these flexibilities in FER.

42388 **(JAERI-M—88-007) Investigation on particle-solid interactions. Basic process relating to the plasma particle deposition profiles in solids.** Yano, Syukuro. (Japan Atomic Energy Research Inst., Tokyo). Feb 1988. 82p. (In Japanese). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88753625/JAW.

Surface deposition probes have been conveniently used to diagnose plasma-wall interactions in recent magnetic plasma confinement devices. Deposition profiles of plasma particles in the surface probes reveal the basic mechanisms of particle-solids interactions as well as the plasma particle transport in the scrape-off-layers. In the first stage of this investigation, this report presents a review of surface probe experiments on various plasma confinement devices reported in 1978 - 1984.

42389 **(JAERI-M—88-009) Development of laminated piezoelectric gas injection valve for JT-60.** Hiratsuka, Hajime; Kawasaki, Kozo; Miyo, Yasuhiko; Kuroda, Takeshi; Ohta, Kazuya; Shimizu, Masatsugu; Asahara, Masaji; Konishi, Kazumasa. (Japan Atomic Energy Research Inst., Tokyo). Feb 1988. 30p. (In Japanese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88753626/JAW.

Gas injection valves of "lift" and "lever" types for JT-60 have been developed with laminated piezoelectric elements. The valves of the two types are remarked as follows: (1) The respective response time and helium leakage rate satisfy the designed specifications, (2) The throughput rates of "lift" and "lever" types are 0.15 ~ 5.65 Pam/sup 3//s and 0.02 ~ 5.87 Pam/sup 3//s respectively, (3) Both types of the valves have been proved to be able to put into actual use in the experimental atmosphere.

42390 **(JAERI-M—88-012) Study of the test section on the fusion engineering facility.** Sagawa, Hisashi; Nakata, Hirokatsu; Kawabe, Takaya; Hirayama, Syoichi. (Japan Atomic Energy Research Inst., Tokyo). Feb 1988. 36p. (In Japanese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88753627/JAW.

The research and development of a nuclear fusion reactor are rapidly making progress in plasma physics, superconductive magnets, heating technology of plasma and so on. The detailed study of a large-scale fusion reactor which uses DT plasma has been started as a next stage of a critical nuclear fusion reactor (JT-60). While the technology of plasma confinement is being developed, the study of reactor engineering technology is very important to put a nuclear fusion reactor to practical use. Therefore the conceptual facility called the fusion engineering facility (FEF) is proposed to be effective for a nuclear fusion reactor development. This report describes the utilization of the test section on the FEF and the characteristics of neutron flux at the test section.

42391 **(JAERI-M—88-014) Japanese contributions to IAEA INTOR Workshop, Phase Two A, Part 3. Chapter I: introduction, chapter II: summary.** Mori, Shigeru; Tomabechi, Ken; Fujisawa, Noboru . (Japan Atomic Energy Research Inst., Tokyo). Feb 1988. 152p. NTIS (US Sales Only), PC A08/MF A01. Order Number DE88753629/JAW.

This report corresponds to Chapter I and II of Japanese contribution report to IAEA INTOR Workshop, Phase Two A, Part 3. The major objectives of the INTOR Workshop Part 3 are to evaluate innovative ideas which would significantly improve the tokamak concept, to study new-selected critical technical issues, that affect the feasibility or practicability of the INTOR concept, to assess scientific and technical data bases, and to conduct critical analyses of the existing INTOR-like designs with the aim of preparing a useful information base for future design work for ITER. To perform the innovations, critical issues, and data base, the following six groups are organized; (A) Impurity control, (B) Operational limits and confinement, (C) Current drive and heating, (D) Electromagnetics, (E) Configuration and maintenance, (F) Blanket and first wall. In addition to those groups, the two disciplinary groups are also organized to do the critical analyses of the existing INTOR-like designs; (G) Physics and (H) Engineering.

42392 **(JAERI-M—88-022) Development of a variable proton ratio ion source.** Watanabe, Kazuhiro; Dairaku, Masayuki; Ebisawa, Noboru . (Japan Atomic Energy Research Inst., Tokyo). Feb 1988. 32p. (In Japanese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88754109/JAW.

Extension of the heating experiment region of JT-60 with neutral beam until the territory of low plasma density is important in order to facilitate the H-mode transition of the beam heated plasma through the heating profile variation. One method of the profile change is reduction in the beam energy so as to keep the shine through beam power under a permissible value while keeping the injection power constant. One of methods is to lower the proton ratio, to increase the molecular ion yield which results in the increase in low energy neutral particles. The injection power also increases by this method. The source chamber of the JT-60 spare ion source was so modified that it can change the plasma volume. The lowest proton ratio of 62 % which is compared with the value of 91 % of JT-60 ion source, was obtained by decreasing chamber depth, decreasing magnetic field strength at the back stream electron beam dump, keeping the filaments near the plasma grid and connection of plasma grid and cathode. Therefore, there is a fair prospect of posibility to expand the heating experiment region. We measured injection power at the proto-type NBI unit. The results indicate that the total injection power of 24 MW which is 20 % larger than the present power is expected to obtain if such method is applied to JT-60 NBI.

42393 **(JAERI-M—88-023) Numerical calculation of high frequency fast wave current drive in a reactor grade tokamak.** Ushigusa, Kenkichi; Hamamatsu, Kiyotaka. (Japan Atomic Energy Research Inst., Tokyo). Feb 1988. 20p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88754110/JAW.

A fast wave current drive with a high frequency is estimated for a reactor grade tokamak by the ray tracing and the quasi-linear Fokker-Planck calculations with an assumption of single path absorption. The fast wave can drive RF current with the drive efficiency of eta/sub CD/ = n-bar/sub e/(10/sup 19/ m/sup -3/)I/sub RC/(A)R(m)/P/sub RF/(W) ~ 3.0 when the wave frequency is selected to be f/f/sub ci/ > 7. A sharp wave spectrum and a <v/sub phchemical bondchemical bond/>/v/sub Te/ ~ 3.0 are required to obtain a good efficiency. A center peaked RF current profile can be formed with an appropriate wave spectrum even in the high temperature plasma.

42394 **(JAERI-M—88-034) Benchmark experiments on a 60 cm-thick graphite cylindrical assembly.** Maekawa, Hiroshi; Ikeda, Yujiro; Oyama, Yukio; Yamaguchi, Seiya; Tsuda, Koichi; Fukumoto, Tooru; Kosako, Kazuaki; Nakamura, Tomoo; Yoshizawa, Michio. (Japan Atomic Energy Research Inst., Tokyo). Feb 1988. 68p. NTIS (US Sales Only), PC A04/MF A01. Order Number DE88753633/JAW.

Integral experiments on a graphite cylindrical assembly have been carried out, using the FNS facility to provide benchmark data for verification of methods and data used in fusion neutronics research. The size of assembly was 63 cm (diameter) by 61 cm (length). Measurements included /sup 235/U, /sup 238/U, /sup 237/Np and /sup 232/Th fission rates ; /sup 27/Al(n,α)/sup 24/Na, /sup 58/Ni(n,2n)/sup 57/Ni, /sup 58/Ni(n,p)/sup 58/Co, /sup 90/Zr(n,2n)/sup 89/Zr, /sup 93/Nb(n,2n)/sup 92m/Nb, /sup 115/In(n,n')/sup 115m/In and /sup 197/Au(n,γ)/sup 198/Au reaction rates. Neutron energy spectra in the assembly, as well as response rates of TLDs and PIN diodes, were also measured. Measured data are presented in tabular form together with estimated errors. A sample calculation using the DOT3.5 code is provided to facilitate the reader understanding of the experiments. Although several different measuring techniques are used in the experiment, the data are mutually consistent. This fact support that present experimental data can be applied to the benchmark verification of methods and data.

42395 **(JAERI-M—88-042) On the analysis of beam driven current in a tokamak.** Tani, Keiji; Yamamoto, Shin; Azumi, Masafumi; Suzuki, Masanobu. (Japan Atomic Energy Research Inst., Tokyo). Mar 1988. 20p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88754122/JAW.

Beam induced plasma current in a tokamak has been analyzed by using an orbit-following Monte-Carlo code. Results indicate that the effect of particle trapping is of great importance. A substantial fraction of fast ion current is induced by the effect of energy diffusion. Taking those important effects into consideration, we have developed a new analytical code in which nummerically derived eigenfunctions of the bounce-averaged, two dimensional Fokker-Planck equation are adopted.

42396 (KEK—87-13, pp 56-64) **Large-output radio frequency power source.** Shinohara, Kibatsu; Matsumoto, Hirobumi. (Nihon Koshuha Co. Ltd., Yokohama (Japan)). Sep 1987. (In Japanese). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88780097/JAW. (CONF-8706325—).

From Meeting on high-power, high-frequency power sources; Oho, Japan (4 Jun 1987).

Demands for large-output radio frequency power sources (RF-PS's) have increasingly been expanding for various industrial uses as well as for accelerators and nuclear fusion. Studies have been focused on automatic synchronization; automatic load matching; use of an external computer for management of operation, control and data transmission; and linkage to other external equipment. For industrial radio frequency power sources, in particular, great importance is attached to reduction in size, energy consumption, costs and maintenance. As an example, an MW-class RF-PS for ICRF (ion cyclotron range of frequency) which was developed by the authors to be used with a nuclear fusion experiment system is described. Its major characteristics are: 1) frequency 20 - 47 MHz, 2) radio frequency output up to 1.5 MW, 3) pulse width up to 100 msec, and 4) load 50 Ω. Requirements to be considered in designing a final-stage amplifier are listed. Improvements are made to achieve matching between the load and the impedance of the final-stage tube over a wide frequency range. Improvements are also made in the anode blocking capacitors. Preventive measures are taken against parastic oscillation and other abnormal oscillations. (Nogami, K.).

42397 (KEK—87-13, pp 110-115) **Radio frequency source for JT-60.** Nagashima, Takashi. (Japan Atomic Energy Research Inst., Naka, Ibaraki. Naka Fusion Research Establishment). Sep 1987. (In Japanese). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88780097/JAW. (CONF-8706325—).

From Meeting on high-power, high-frequency power sources; Oho, Japan (4 Jun 1987).

Japan Atomic Energy Research Institute has been conducting radio frequency heating experiments with a critical plasma experiment system called JT-60. The radio frequency heating system for JT-60 consists of three LHRF (lower hybrid range of frequency) heating units and one ICRF (ion cyclotron range of frequency)

heating unit. Each LHRF heating unit has eight large-power klystrons to give an oscillator output of 8 MW. The RF signals (around 2 GHz) generated is divided into two: one is sent to the level controller and the other is used for phase detection. The level controler acts to control the RF power level and cut the RF power after receiving an interlock signal from an on/off controller. The main circuit output signal from the level controller is divided into 8 x 2, after amplified up to about 1 MW. Eight of them are used as reference signal for automatic gain control while the others serving as phase control signal for the main circuit. The ICRF heating unit, on the other hand, consists of eight amplifying units, each with a final output of 750 kW. Two final outputs are combined into 1.5 MW and sent to the tokamak system. The exciter component is composed of a signal generator, level controller, reference level generator, divider, phase controller, and amplitude/phase controller for exciting the 750 kW amplifying units. (Nogami, K.).

42398 (KEK—87-13, pp 116-123) **Klystron power source for nuclear fusion.** Nakada, Kiyoshi. (Nisshin Electric Co. Ltd., Kyoto (Japan)). Sep 1987. (In Japanese). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88780097/JAW. (CONF-8706325—).

From Meeting on high-power, high-frequency power sources; Oho, Japan (4 Jun 1987).

This report describes the power sources for the radio frequency heating system for JT-60, which is installed in the Japan Atomic Energy Research Institute as klystron power sources for nuclear fusion, and also decribes the power sources for an output test system which was constructed to be used for aging and evaluation tests of the klystrons for the heating system. The basic performance requirements for the power sources are shown. The output test system uses an A.C.-side thyristor switch to supply pulsed collector voltage, while in the JT-60 LHRF (lower hybrid range of frequency) heating system, a collector volage is applied continuously and pulse control of the anode voltage is performed by a regulator tube. The anode power source supplies power to eight klystrons. A crowbar switch unit is incorporated in order to reduce the energy from the power sources down to 50 joules or less when short circuit occurs inside a klystron. Some test results are shown, including mrasurements of collector power source output wave profile, crowbar switch actuation characteristics, effect of power source voltage variation on the anode voltage, and crowbar switch actuation current. (Nogami, K.).

42399 (KEK—87-13, pp 124-131) **Large-power radio frequency amplifier.** Hasegawa, Atsushi. (Denki Kogyo Co. Ltd., Tokyo (Japan)). Sep 1987. (In Japanese). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88780097/JAW. (CONF-8706325—).

From Meeting on high-power, high-frequency power sources; Oho, Japan (4 Jun 1987).

This report describes some aspects of amplifiers with frequencies and outputs in the range of about 100 KHz to 200 MHz and 100 kW to 1 MW, respectively. In particular, the report is focused on major typical radio frequency amplifiers which have been developed by the authors, and electronic tubes used in these amplifiers. Capacitor coupling is mainly used in output power coupling circuits because such circuits are simple in structure and easy to adjust over a wide range of variable frequencies. In a quarter wave length circuit, output power coupling is made in the neighborhood of the vacuum tube, but the voltage near the tube decreases at higher frequencies. Thus a 3/4 wave length circuit is used at higher frequencies, with output power coupling made at an appropriate voltage. Specifications and features of typical radio frequency output cavities which have been developed by the authors are then described. A coaxial cylinder type quarter wave length amplifier presented has two variable frequency ranges which are shifted by changing the length of the cylinder. Another amplifier, which is of a coaxial angular type with a 3/4 wave ength circuit, is also described. (Nogami, K.).

42400 (KEK—87-13, pp 136-144) **Large-power klystron.** Kawakami, Yoshio; Miyake, Setsuo; Oya, Keiji. (Toshiba Corp., Kawasaki, Kanagawa (Japan)). Sep 1987. (In Japanese). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88780097/JAW. (CONF-8706325—).

From Meeting on high-power, high-frequency power sources; Oho, Japan (4 Jun 1987).

This report outlines large-power klystrons of the continuous wave output type (including long pulse type) developed by Toshiba Corporation, centering on 1 MW long pulse (10 sec.) klystron E3778 and 1.2 MW continuous wave output klystron E3786. E3778 was developed jointly with the Japan Atomic Energy Institute to be used as plasma heating radio-frequency source for JT-60, a large-size tokamak system installed in JAERI. E3786 was developed under the guidance of KEK of the Japanese Education Ministry to be used as particle acceleration radio-frequency source for Tristan, a large-size accelerator installed in KEK. In developing and designing a large-power klystron, particular consideration should be given to the following items: (1) radio frequency component serving for high-efficiency, high-stability operation, (2) electron gun able to operate stably at high voltage, (3) collector resistant to large power, and (4) output window resistant to large power. The output window is a key component for developing a high-output continuous wave klystron. The last part of this report is focused on effects of temperature on ceramic windows used in the above-mentioned two klystrons. (Nogami, K.).

42401 **(KFK—4355) NET model coil test possibilities. Final study report.** Erb, J.; Gruenhagen, A.; Herz, W.; Jentzsch, K.; Komarek, P.; Lotz, E.; Malang, S.; Maurer, W.; Noether, G.; Ulbricht, A. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Projekt Kernfusion; Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.); Paul Scherer Inst. (PSI), Villigen (Switzerland); Netherlands Energy Research Foundation, Petten). Nov 1987. 211p. NTIS (US Sales Only), PC A10/MF A01. Order Number DE88753832/JAW.

A single full size coil for NET/INTOR represents an investment of the order of 40 MUC (Million Unit Costs). Before such an amount of money or even more for the 16 TF coils is invested as much risks as possible must be eliminated by a comprehensive development programme. In the course of such a programme a coil technology verification test should finally prove the feasibility of NET/INTOR TF coils. This study report is almost exclusively dealing with such a verification test by model coil testing. These coils will be built out of two Nb/sub 3/Sn-conductors based on two concepts already under development and investigation. Two possible coil arrangements are discussed: A cluster facility, where two model coils out of the two Nb/sub 3/TF-conductors are used, and the already tested LCT-coils producing a background field. A solenoid arrangement, where in addition to the two TF model coils another model coil out of a PF-conductor for the central PF-coils of NET/INTOR is used instead of LCT background coils. Technical advantages and disadvantages are worked out in order to compare and judge both facilities. Costs estimates and the time schedules broaden the base for a decision about the realisation of such a facility. (orig.)

42402 **(KFK—4365) Study on nuclear heat load tolerable for NET/TF coils cooled by internal flow of helium II.** Hofmann, A. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Technische Physik; Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Projekt Kernfusion). Feb 1988. 46p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88753833/JAW.

NbTi cables cooled by internal flow of superfluid helium are considered an option for the design of NETTF coils with about 11 T peak fields. Starting from an available winding cross section of 0.61x0.61 m^2 for a 8 MA turns coil made of a 16 kA conductor it is shown that sufficient hydraulic cross section can be provided within such cables to remove the expected thermal load resulting from nuclear heating with exponential decay from inboard to outboard side of the winding. The concept is a pancake type coil with 1.8 K helium fed-in the high field region of each pancake. The temperature distribution within such coils is calculated, and the local safety margin is determined from temperature and field. The calculation takes account of nuclear and a.c. heating, and of thermal conductance between the individual layers and the coil casing. It is shown that operation with 1.8 K inlet and about 3 K outlet temperature is possible. The electrical insulation with about 0.5 mm thickness proves to provide sufficient thermal insulation. No additional

thermal shield is required between the coil casing and the winding package. Two different types of conductors are being considered: a) POLO type cable with quadratic cross section and a central circular coolant duct, and b) an LCT type cable with two conductors wound in hand. Both concepts with about 500 m length of the cooland channels are shown to meet the requirements resulting from a peak nuclear heat load of 0.3 mWcm^3 in the inboard turns. The hydraulic diameters are sufficient to operate each coils with self-sustained fountain effect pumps. Even appreciably higher heat loads with up to 3 mWcm^3 of nuclear heating can be tolerated for the POLO type cable when the hydraulic diameter is enlarged to its maximum of 17 mm. (orig.)

42403 **(LAFI—104) Liquid metals in thermonuclear reactors with magnetic confinement.** Karasev, B.G.; Lielausis, O.A.; Murav'ev, E.V.; Tananaev, A.V. (AN Latvijskoj SSR, Riga. Inst. Fiziki). 1987. 32p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88701689/JAW.

The use of liquid metals as promising coolants and for tritium recovery in fusion reactor blankets is discussed. MHD problems of liquid metal pumping through a strong magnetic field and the data base for calculation methods have been paid special attention. The application of liquid metals to plasma impurity control and the first wall protection is considered as well, and schematic diagrams of the corresponding devices are presented along with their parameter estimations. The expected positive impact of liquid metal use on the fusion reactor characteristics is generalized. 32 refs.; 11 figs.

42404 **(NEANDC(E)—241/L) Calculation of fission spectrum integrals for the energy region 15-20 MeV of fission neutron spectra.** Walsh, R.L. (Nuclear Energy Agency, 75 - Paris (France). Nuclear Data Committee). Sep 1987. 24p. (INDC(FR)—70/L). NTIS (US Sales Only), PC A03; 1; GPO Dep. Order Number DE88011273/JAW.

For fission reactors in general and, in particular, for the proposed fusion-fission hybrid reactors [Ha82] where the D-T fusion reaction provides a source of 14 MeV neutrons to reed ^{233}U or ^{239}Pu fuel, it is important to know the relative number of high energy neutrons released in the fission reaction itself. Further, this number should be known as a function of the energy (0-14 MeV say) of the neutron which causes the fission. To calculate this high energy contribution it is first necessary to calculate the fission neutron energy spectrum. Experimental data above 10 MeV in the spectrum are generally not or high accuracy, because of low count rates. Two recent formalisms for calculations of the fission neutron spectrum were considered for the present work. 15 refs., 6 figs., 7 tabs.

42405 **(NIIEFA-P-B—0760) Ideal-conducting torus with ellyptical meridional cross-section in a magnetic field.** Mingalev, B.S. (Nauchno-Issledovatel'skij Inst. Ehlektrofizicheskoj Apparatury, Leningrad (USSR)). 1987. 18p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703456/JAW.

Analytic solution for magnetostatic problem of ideal-conducting torus with a small elliptical cross section and a high aspect ratio is obtained. The solution can be of interest when selecting shape of inductor winding for tokamak with plasma filament small cross section of non-circular shape. Results of magnetic field calculations for different values of the torus large radius R alongside with a and b - ellipse half-axis dimensions of the torus small cross section - are presented. It follows from the results presented that the field inside the torus constitutes 1-4 % of the external field and decreases with an increase in R/a parameter. 3 refs.; 2 figs.; 3 tabs.

42406 **(NIIEFA-P-B—0763) Power supply system for a tokamak with strong magnetic field and adiabatic compression heating.** Bystrov, M.N.; Druzhinin, A.S.; Kornakov, E.V.; Kuchinskij, V.G.; Larionov, B.A.; Roshal', A.G.; Spevakova, F.M.; Stolov, A.M.; Yavno, A.Kh.; Azizov, Eh.A. (Nauchno-Issledovatel'skij Inst. Ehlektrofizicheskoj Apparatury, Leningrad (USSR)). 1987. 10p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88703457/JAW.

Power supply system for a tokamak with a strong magnetic field and adiabatic compression heating is described. Main characteristics of toroidal and poloidal field coil supply systems are presented. 7 figs.

42407 **(NIIEFA-P-B—0766) Electromagnetic system of a tokamak with a strong magnetic field.** Krylov, V.A.; Kuchinskij, V.G.; Krivchenkov, Yu.M. and others. (Nauchno-Issledovatel'skij Inst. Ehlektrofizicheskoj Apparatury, Leningrad (USSR)). 1987. 11p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703459/JAW.

Electromagnetic system of a tokamak with a strong magnetic field and plasma adiabatic compression for its heating is described. Performance, structure description and results of calculating the strain-deformed state of its elements are presented. 2 refs.; 5 figs.; 2 tabs.

42408 **(NIIEFA-P-OM—0758) Experimental and calculating study on the stressed state of superconducting coils of toroidal field in the T-15 tokamak.** Vaulina, I.G.; Gusev, S.V.; Sivkova, G.N. and others. (Nauchno-Issledovatel'skij Inst. Ehlektrofizicheskoj Apparatury, Leningrad (USSR)). 1987. 12p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703460/JAW.

Results of calculational and experimental atudy of stress-deformed state of superconducting coils of the T-15 tokamak toroidal field are presented. The calculations are made using the method of finite elements and refined theory of cores. Experimental studies were carried out using elastic tensometric model of polymer materials. Test results are compared with the calculational results. Divergence between calculational and experimental values of displacement of characteristic points in the unit does not exceed 20 %. Results of model studies confirm the expediency of the calculational model used for designing SOTP unit for the T-15 tokamak. 10 refs.; 7 figs.; 2 tabs.

42409 **(ORNL/FEDC—87/7) ETR/ITER systems code.** Barr, W.L.; Bathke, C.G.; Brooks, J.N.; Bulmer, R.H.; Busigin, A.; DuBois, P.F.; Fenstermacher, M.E.; Fink, J.; Finn, P.A.; Galambos, J.D.; Gohar, Y.; Gorker, G.E.; Haines, J.R.; Hassanein, A.M.; Hicks, D.R.; Ho, S.K.; Kalsi, S.S.; Kalyanam, K.M.; Kerns, J.A.; Lee, J.D.; Miller, J.R.; Miller, R.L.; Myall, J.O.; Peng, Y-K.M.; Perkins, L.J.; Spampinato, P.T.; Strickler, D.J.; Thomson, S.L.; Wagner, C.E.; Willms, R.S.; Reid, R.L. (ed.). (Oak Ridge National Lab., TN (USA)). Apr 1988. Contract AC05-84OR21400. 199p. NTIS, PC A09;3. Order Number DE88010756/JAW.

A tokamak systems code capable of modeling experimental test reactors has been developed and is described in this document. The code, named TETRA (for Tokamak Engineering Test Reactor Analysis), consists of a series of modules, each describing a tokamak system or component, controlled by an optimizer/driver. This code development was a national effort in that the modules were contributed by members of the fusion community and integrated into a code by the Fusion Engineering Design Center. The code has been checked out on the Cray computers at the National Magnetic Fusion Energy Computing Center and has satisfactorily simulated the Tokamak Ignition/Burn Experimental Reactor II (TIBER) design. A feature of this code is the ability to perform optimization studies through the use of a numerical software package, which iterates prescribed variables to satisfy a set of prescribed equations or constraints. This code will be used to perform sensitivity studies for the proposed International Thermonuclear Experimental Reactor (ITER). 22 figs., 29 tabs.

42410 **(ORNL/TM—10708) High vacuum chamber for elevated-temperature tensile testing.** Braski, D.N.; Gibson, J.R.; Turner, L.J.; Sy, R.L. (Oak Ridge National Lab., TN (USA)). May 1988. Contract AC05-84OR21400. 20p. NTIS, PC A03. Order Number DE88013624/JAW.

A chamber for tensile testing vanadium alloys at pressure of 10/sup {minus}5/ Pa (10/sup {minus}7/ torr) and temperatures up to 800{degree}C has been designed and fabricated. Features of the test system include an 20.3-cm (8-in.) cryopump and a tungsten element furnace. The chamber can be pumped to a pressure less than 10/sup {minus}4/ Pa (10/sup {minus}6/ torr) in less than 10 min.

The stress-strain curve obtained for the V-20Ti alloy at 600{degree}C was consistent with results obtained for the same alloy on a second, proven machine. 1 ref., 10 figs.

42411 **(PPPL—2521) Material behavior and materials problems in TFTR [Tokamak Fusion Test Reactor].** Dylla, H.F.; Ulrickson, M.A.; Owens, D.K.; Heifetz, D.B.; Mills, B.E.; Pontau, A.E.; Wampler, W.R.; Doyle, B.L.; Lee, S.R.; Watson, R.D.; Croessmann, C.D. (Princeton Univ., NJ (USA). Plasma Physics Lab.; Sandia National Labs., Livermore, CA (USA); Sandia National Labs., Albuquerque, NM (USA)). May 1988. Contract AC02-76CH03073;AC04-76DP00789. 33p. (SAND—88-0885C; CONF-871036—35). NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88011165/JAW.

From 3. international conference on fusion reactor materials; Karlsruhe, F.R. Germany (4 Oct 1987).

This paper reviews the experience with first-wall materials over a 20-month period of operation spanning 1985--1987. Experience with the axisymmetric inner wall limiter, constructed of graphite tiles, will be described including the necessary conditioning procedures needed for impurity and particle control of high power (≦20 MW) neutral injection experiments. The thermal effects in disruptions have been quantified and no significant damage to the bumper limiter has occurred as a result of disruptions. Carbon and metal impurity redeposition effects have been quantified through surface analysis of wall samples. Estimates of the tritium retention in the graphite limiter tiles and redeposited carbon films have been made based on analysis of deuterium retention in removed graphite tiles and wall samples. New limiter structures have been designed using a 2D carbon/carbon (C/C) composite material for RF antenna protection. Laboratory tests of the important thermal, mechanical and vacuum properties of C/C materials will be described. Finally, the last series of experiments in TFTR with in-situ Zr/Al surface pumps will be described. Problems with Ar/Al embrittlement have led to the removal of the getter material from the in-torus environment. 53 refs., 8 figs., 3 tabs.

42412 **(PPPL—2536) Environmental monitoring report for calendar year 1987.** Stencel, J.R. (Princeton Univ., NJ (USA). Plasma Physics Lab.). May 1988. Contract AC02-76CH03073. 89p. NTIS, PC A05/MF A01;3. Order Number DE88012721/JAW.

The results of the 1987 environmental monitoring program for the Princeton Plasma Physics Laboratory (PPPL) are presented and discussed. Two of three large tokamak machines, the Princeton Beta Experiment Modification (PBX-M) and the Tokamak Fusion Test Reactor (TFTR) were in operation during the year. In addition, the S-1 Spheromak and the Radio-Frequency Test Facility (RFTF) were operated on a limited basis in 1987. The Environmental Committee which is a standing committee of the Executive Safety Board (ESB) continued to review items of environmental importance. During CY87 no adverse effects to the environment or public resulted from any operational program activities at PPPL, and the Laboratory was in compliance with all applicable Federal, State, and local environmental regulations. 41 refs., 24 figs., 34 tabs.

42413 **(SLAC-PUB—4034) Heavy Ion Fusion Systems Assessment study.** Dudziak, D.J.; Herrmannsfeldt, W.B. (Los Alamos National Lab., NM (USA); Stanford Linear Accelerator Center, Menlo Park, CA (USA)). Jul 1986. Contract AC03-76SF00515. 15p. (CONF-860510—22). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88012999/JAW.

From Symposium on heavy ion inertial fusion; Washington, DC, USA (27 May 1986).

The Heavy Ion Fusion Systems Assessment (HIFSA) study was conducted with the specific objective of evaluating the prospects of using induction linac drivers to generate economical electrical power from inertial confinement fusion. The study used algorithmic models of representative components of a fusion system to identify favored areas in the multidimensional parameter space. The resulting cost-of-electricity (COE) projections are comparable to those from other (magnetic) fusion scenarios, at a plant size of 100 MWe.

42414 **(UCID—21404) Technology and physics in the Tokamak Program: The need for an integrated, steady-state R&D tokamak experiment.** (General Atomics Co., San Diego, CA (USA); Lawrence Livermore National Lab., CA (USA)). May 1988. Contract W-7405-ENG-48. 61p. (GA-A—19305). NTIS, PC A04/MF A01;1; GPO Dep. Order Number DE88011754/JAW.

The Steady-state Tokamak (STE) Experiment is a proposed superconducting-coil, hydrogen-plasma tokamak device intended to address the integrated non-nuclear issues of steady state, high-power tokamak physics and technology. Such a facility has been called for in the US program plan for the mid 1990's, and will play a unique role in the world-wide fusion effort. Information from STE on steady-state current drive, plasma control, and high power technology will contribute significantly to the operating capabilities of future steady-state devices. This paper reviews preliminary designs and expected technological contributions to the US and world fusion reactor research from each of the above mentioned reactor systems. This document is intended as a proposal and feasibility discussion and does not include exhaustive technical reviews. 12 figs., 3 tabs. (DWL)

42415 **(UCID—21417) Solid state laser technology for inertial confinement fusion: A collection of articles from "Energy and Technology Review".** (Lawrence Livermore National Lab., CA (USA)). Jun 1988. Contract W-7405-ENG-48. 73p. NTIS, PC A04/MF A01;1; GPO Dep. Order Number DE88011752/JAW.

This paper contains reprinted articles that record several milestones in laser research at LLNL. "Neodymium-Glass Laser Research and Development at LLNL" recounts the history of the Laser Program and our work on neodymium-glass lasers. "Nova Laser Technology" describes the capabilities of the Nova laser and some of its uses. "Building Nova: Industry Relations and Technology Transfer" illustrates the Laboratory's commitment to work with US industry in technology development. "Managing the Nova Laser Project" details the organization and close monitoring of costs and schedules during the construction of the Nova laser facility. The article "Optical Coatings by the Sol-Gel Process," describes our chemical process for making the damage-resistant, antireflective silica coatings used on the Nova laser glass. The technical challenges in designing and fabricating the KDP crystal arrays used to convert the light wave frequency of the Nova lasers are reported in "Frequency Conversion of the Nova Laser." Two articles, "Eliminating Platinum Inclusions in Laser Glass" and "Detecting Microscopic Inclusions in Optical Glass," describe how we dealt with the problem of damaging metal inclusions in the Nova laser glass. The last article reprinted here, "Auxilliary Target Chamber for Nova," discusses the diversion of two of Nova's ten beamlines into a secondary chamber for the purpose of increasing our capacity for experimentation.

42416 **(UCLA/PPG—1046) Effects of nonuniform surface heat flux and uniform volumetric heating on blanket design for fusion reactors.** Hasan, M.Z. (California Univ., Los Angeles (USA)). May 1988. Contract FG03-86ER52126. 25p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88011710/JAW.

An analytical solution for the temperature profile and film temperature drop for fully-developed, laminar flow in a circular tube is provided. The surface heat flux varies circcimferentally but is constant along the axis of the tube. The volulmetric heat generation is uniform in the fluid. The fully developed laminar velocity profile is approximated by a power velocity profile to represent the flattening effect of a perpendicular magnetic field when the coolant is electrivally conductive. The presence of volumetric heat generation in the fluid adds another component to the film temperature drop to that due to the surface heat flux. The reduction of the boundary layer thickness by a perpendicular magnetic field reduces both of these two film temperature drops. A strong perpendicular magnetic field can reduce the film termperatiure drop by a factor of two if the fluid is electrically conducting. The effect of perpendicualr magnetic field)or the flatness of the velocity profile) is less pronounced on teh film termperature drop due to nonuniform surfacae heat flux than on that due to uniform surface heat flux. An

example is provided to show the relative effects on these two film temperd

42417 **(UCLA/PPG—1159) Deuterium pumping and erosion behavior of selected graphite materials under high flux plasma bombardment in PISCES.** Hirooka, Y.; Conn, R.W.; Goebel, D.M.; LaBombard, B.; Lehmer, R.; Leung, W.K.; Nygren, R.E.; Ra, Y. (California Univ., Los Angeles (USA). Inst. for Plasma and Fusion Research). Jun 1988. Contract AS03-84ER52104. 18p. (CONF-880512—8). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88012408/JAW.

From 8. international conference on plasma surface interactions in controlled fusion devices; Julich, F.R. Germany (2 May 1988).

Deuterium plasma recycling and chemical erosion behavior of selected graphite materials have been investigated using the PISCES-A facility. These materials include: Pyro-graphite; 2D-graphite weave; 4D-graphite weave; and POCO-graphite. Deuterium plasma bombardment conditions are: fluxes around 7 {times} 10^{17} ions s/sup {minus}1/cm/sup {minus}2/; exposure time in the range from 10 to 100 s; bombarding energy of 300 eV; and graphite temperatures between 20 and 120{degree}C. To reduce deuterium plasma recycling, several approaches have been investigated. Erosion due to high-fluence helium plasma conditioning significantly increases the surface porosity of POCO-graphite and 4D-graphite weave whereas little change for 2D-graphite weave and Pyro-graphite. The increased pore openings and refreshed in-pore surface sites are found to reduce the deuterium plasma recycling and chemical erosion rates at transient stages. The steady state recycling rates for these graphite materials can be also correlated to the surface porosity. Surface topographical modification by machined-grooves noticeably reduces the steady state deuterium recycling rate and the impurity emission from the surface. These surface topography effects are attributed to co-deposition of remitted deuterium, chemically sputtered hydrocarbon and physically sputtered carbon under deuterium plasma bombardment. The co-deposited film is found to have a characteristic surface morphology with dendritic microstructures. 18 ref., 4 figs., 1 tab.

42418 **(UCRL—97405-Rev.1) Triton memory time in solid DT and its nuclear polarization.** Souers, P.C.; Fearon, E.M.; Mapoles, E.R.; Sater, J.D.; Collins, G.W.; Gaines, J.R.; Sherman, R.H.; Bartlit, J.R. (Lawrence Livermore National Lab., CA (USA)). May 1988. Contract W-7405-ENG-48. 9p. (CONF-880505—19-Rev.1). NTIS, PC A02/MF A01;1; GPO Dep. Order Number DE88012234/JAW.

From 3. topical meeting on tritium technology in fission, fusion and isotopic applications; Toronto, Canada (1 May 1988).

The expected value of nuclear spin polarization to inertial confinement fusion is recapitulated. A comparison of brute force polarization versus dynamic nuclear polarization, as applied to solid deuterium-tritium, is given, and the need for a long triton polarization memory time (longitudinal nuclear relaxation time) is shown. The time constant for 25 mol%T_2-50 DT-25 D_2 (D-T) is a short 0.3 s at 5 K and waiting in the presence of tritium radioactivity lowers it to 0.1 s. Enriched 90 to 96% molecular DT has been synthesized and held 3 to 4 hours at 10 K, which lowers the overall J = 1 T_2 concentration to about 0.1%. The resulting memory time can be raised in this way to 0.7 to 0.8 s. These samples were then melted and nH_2 added, which increased the memory times to 6 to 8 s -- an increase of twenty-fold over regular D-T at 5 to 6 K. The theory shows that the species shortening the triton memory time is the J = 1 T_2, which can be reduced in our samples only by radioactive self-catalysis. Cryogenic distillation is considered as a possible means of removing the J = 1 T_2 from molecular DT. 33 refs., 7 figs., 3 tabs.

42419 **(UCRL—97518-Rev.1) Design of a tritium recovery system.** Sherry, R.J.; Miller, L.C. (Lawrence Livermore National Lab., CA (USA)). May 1988. Contract W-7405-ENG-48. 5p. (CONF-880505—23-Rev.1). NTIS, PC A02/MF A01;1; GPO Dep. Order Number DE88012230/JAW.

From 3. topical meeting on tritium technology in fission, fusion and isotopic applications; Toronto, Canada (1 May 1988).

A new effluent cleanup system for tritium recovery (Vacuum Effluent Recovery System, abbreviated VERS) has been designed by the Lawrence Livermore National Laboratory for use at their tritium facility in cleaning argon box atmospheres and pump exhausts. It is the standard catalyst-molecular sieve (zeolite) system, and is directly descended from the cleanup system at Mound Laboratory. This paper deals with possible engineering improvements as well as areas of difficulty.

42420 **Magnet alignment in the Mirror Fusion Test Facility-B tandem mirror.** Hopper, E.B. Jr.; Bulmer, R.H.; Higgins, L.L. (Lawrence Livermore National Lab., Univ. of California, P.O. Box 808, Livermore, CA (US)). *Fusion Technology;* **13**: No. 3, 503-509(Mar 1988). Contract W-7405-ENG-48.

Magnet alignment in the Mirror Fusion Test Facility-B (MFTF-B) tandem mirror has been measured by electron beams propagated along the axis. A least-squares fit to the data has been obtained by use of singular-value decomposition techniques. This fit determines the positions of the magnets that sensitively effect displacements of the field lines from alignment and, thus, the net geodesic curvature that drives radial transport. The magnets are determined to be aligned accurately enough that the MFTF-B trim coils can correct the field errors and reduce the neoclassical radial transport to an acceptable value.

42421 **Test of the power-carrying capability of water-dielectric-loaded ion cyclotron heating waveguide launchers.** Jaycor, K.G.M. (Plasma Technology Div., 3547 Voyager Street, Suite 104, Torrance, CA (US)). *Fusion Technology;* **13**: No. 3, 495-502(Mar 1988).

An external waveguide launcher is an alternative to an internal loop for launching high-power ion cyclotron radiation into the magnetically confined plasma of a fusion reactor. Water, filling the waveguide, can perform the dual function of dielectric medium and coolant, while remaining highly insensitive to the 14-MeV neutron flux from a fusion reactor. Water-filled waveguides provide two distinctive reactor engineering advantages: 1. The waveguide dimensions for transmitting waves at the ion cyclotron frequencies can be reduced by almost an order of magnitude. 2. The problem of removing the heat deposited by neutrons throughout the volume of a solid dielectric-filled waveguide is precluded by the flow of a fluid dielectric through the waveguide ducts. The results of tests on the power-handling capacity of a water-loaded-dielectric waveguide (WR1150) at frequencies of —80 MHz are presented. A tunable radio-frequency cavity, which when filled with water resonates at 80 MHz, was used to achieve electromagnetic stress levels that approach that which ion cyclotron heating launchers would have to withstand in a fusion reactor. The tests show that the water-filled WR1150 waveguide is capable of transmitting ≧500 kW at 80 MHz.

42422 **Helium flow reversal with neutral beam injection and electron cyclotron resonance heating in TIBER-II.** Malik, M.A.; Indireshkumar, K.; Mandrekas, J.; Stacey, W.M. Jr.; Ogden, T.W. (Georgia Institute of Technology Fusion Research Center, Atlanta, GA (US)). *Fusion Technology;* **13**: No. 3, 432-437(Mar 1988).

Impurity flow reversal based on coinjected neutral beams and on electron cyclotron resonance heating are considered as possible mechanisms for alpha ash removal from tokamak reactors. Both formalisms are applied to the TIBER-II parameters and preliminary results are reported.

42423 **Alpha-particle effects on magnetohydrodynamic stability in the engineering test reactor tokamak.** Van Dam, J.W.; Fu, G.Y. (Institute for Fusion Studies, The Univ. of Texas at Austin, Austin, TX (US)). *Fusion Technology;* **13**: No. 3, 423-427(Mar 1988).

Estimates based on the proposed parameters for a long-pulse ignition tokamak device, the Engineering Test Reactor, indicate that it is likely that alpha particles will resonantly destabilize high torodial mode number magnetohydrodynamic ballooning modes, as well as low mode number global types of Alfven modes, which could be problematic for loss of fusion power. Also, nonresonant enhancement of stability by energetic alpha particles, for the pur-

pose of access into the high-beta second regime of stability, appears to be unlikely for such a device.

42424 **Influence of fast alpha diffusion and thermal alpha buildup on tokamak reactor performance.** Uckan, N.A.; Tolliver, J.S.; Houlberg, W.A.; Attenberger, S.E. (Oak Ridge National Lab., Fusion Energy Div., P.O. Box Y, Oak Ridge, TN (US)). *Fusion Technology;* **13**: No. 3, 411-422(Mar 1988).

The effect of fast alpha diffusion and thermal alpha accumulation on the confinement capability of a candidate Engineering Test Reactor plasma (Tokamak Ignition/Burn Experimental Reactor) in achieving ignition and steady-state driven operation has been assessed using both global and 1-1/2-dimensional transport models. Estimates are made of the threshold for radial diffusion of fast alphas and thermal alpha buildup. It is shown that a relatively low level of radial transport, when combined with large gradients in the fast alpha density, leads to a significant radial flow with a deleterious effect on plasma performance. Similarly, modest levels of thermal alpha concentration significantly influence the ignition and steady-state burn capability.

42425 **A semianalytic method for the solution of the steady-state steam generator equations.** Tzanos, C.P. (Argonne National Lab., Reactor Analysis and Safety Div., 9700 South Cass Avenue, Argonne, IL (US)). *Nuclear Technology;* **80**: No. 3, 380-391(Mar 1988).

A model was developed for steady-state steam generator analysis for purposes of continuous on-line data validation, plant state verification, and fault identification. The basic features of this model are as follows: 1. The water (steam) temperature in the subcooled and superheated regions is written as a quadratic function of enthalpy and the system equations are solved analytically. 2. The same equations are also solved analytically in the nucleate and film boiling regions. 3. The departure from nucleate boiling quality is determined from the iterative solution of a transcendental equation. These features allow the use of large nodes in each region and the direct determination of the region boundaries. Applications to typical steam generator problems showed computation times of 0.025 s. The analysis of four Energy Technology Engineering Center experiments showed very good agreement between model predictions and measurements.

42426 **Helium-3 functions in tokamak-pumped laser systems.** Jassby, D.L. (Princeton Univ., Plasma Physics Lab., P.O. Box 451, Princeton, NJ (US)). *Fusion Technology;* **13**: No. 3, 463-472(Mar 1988).

Helium-3 placed in an annular cell or array of cells around a tokamak fusion generator can convert moderated fusion neutrons to energetic ions by the /sup 3/He(n,p)T reaction and thereby excite gaseous lasants mixed with the /sup 3/He while simultaneously breeding tritium. The required /sup 3/He inventory is —5 kg for large tokamak devices. Special configurations of toroidal field magnets, neutron moderators, and reflectors must be incorporated to maximize the neutron flux in the laser cell. The annular laser radiation can be coupled to an unstable resonator at the top of the tokamak and extracted as a single output beam.

42427 **Exploring the competitive potential of magnetic fusion energy: The interaction of economics with safety and environmental characteristics.** Holdren, J.P.; Berwald, D.H.; Budnitz, R.J.; Crocker, J.G.; Delene, J.G.; Endicott, R.D.; Kazimi, M.S.; Krakowski, R.A.; Logan, B.G.; Schultz, K.R. (Univ. of California, Berkeley Energy and Resources Program, Berkeley, CA (US)). *Fusion Technology;* **13**: No. 1, 7-56(Jan 1988).

The Senior Committee on Environmental, Safety, and Economic Aspects of Magnetic Fusion Energy (ESECOM) summarizes its recent assessment of magnetic fusion energy's (MFE's) prospects for providing energy with economic, environmental, and safety characteristics that would be attractive compared with other energy sources (mainly fission) available in the time frame of the year 2015 and beyond. Accordingly, ESECOM has given particular attention to the interaction of environmental, safety, and economic characteristics of a variety of magnetic fusion reactors, and compared those fusion cases with a variety of fission cases. Eight fusion cases, two fusion-fission hybrid cases, and four fission cases are examined, using consistent economic and safety models, to permit exploration of the environmental, safety, and economic potential of fusion concepts using a wide range of possible materials choices, power densities, power conversion schemes, and fuel cycles.

42428 **Superconducting magnets for fusion applications.** Henning, C.D. (Lawrence Livermore Lab., CA (USA)). pp 41-51 of Advances in cryogenic engineering. Volume 33. Fast, R.W. (ed.). New York, NY; Plenum Press (1988). (CONF-8706125—). Contract W-7405-ENG-48.

From Cryogenic engineering conference; St. Charles, IL, USA (14 Jun 1987).

Advances and future requirements in magnet technology and materials studies are discussed for thermonuclear reactors in general and for the Large Coil Program, the MFTF, and the TIBER in particular. Performance and materials requirements and test results are assessed for niobium-tin and niobium-titanium alloys and JBR-75 steel as well as for several epoxide and polyimide insulator materials. Critical current density versus neutron fluence, helium diffusion and leakage, and radiation effects on compression and flexural strength and crack propagation behavior are evaluated for these materials according to TIBER design parameters.

42429 **Quench detection by fluid dynamic means in cable-in-conduit superconductors.** Dresner, L. (Oak Ridge National Lab., TN (USA)). pp 167-174 of Advances in cryogenic engineering. Volume 33. Fast, R.W. (ed.). New York, NY; Plenum Press (1988). (CONF-8706125—). Contract AC05-84OR21400.

From Cryogenic engineering conference; St. Charles, IL, USA (14 Jun 1987).

The tight confinement of the helium in cable-in-conduit superconductors creates protection problems because of the pressure rise that can occur during a quench. But the same pressure rise offers the possibility of a non-electrical means of detecting incipient quenches by monitoring the outflow from the various hydraulic paths of the magnet. If the method is to work, the signal must be large enough to be detected unambiguously at an early time, and must not depend too strongly on the length, Joule power density, or rate of growth of the initial normal zone. This paper explores by calculation the degree to which these conditions can be met. The Westinghouse Large Coil Task coil is used as an example.

42430 **Operating experience in the IFSMTF vapor-cooled lead system.** Lue, J.W.; Fehling, D.T.; Fietz, W.A.; Lubell, M.S.; Luton, J.N.; Schwenterly, S.W.; Shen, S.S.; Stamps, R.E.; Thompson, D.H.; Wilson, C.T.; Kato, T. (Oak Ridge National Lab., TN (USA)). pp 259-266 of Advances in cryogenic engineering. Volume 33. Fast, R.W. (ed.). New York, NY; Plenum Press (1988). (CONF-8706125—). Contract AC05-84OR21400.

From Cryogenic engineering conference; St. Charles, IL, USA (14 Jun 1987).

The International Fusion Superconducting Magnet Test Facility uses six pairs of vapor-cooled leads to introduce electric power to six test coils. Heat loss through the leads constitutes the single largest heat load source to the cryogenic system. A few joints between power buses and leads were found to be inadequate during preliminary single-coil tests. This series of tests also pointed to the need for automatic control of helium flow through the leads. By the time full-array tests were started a working scheme had developed that required little attention to the leads and had little impact on the refrigerator between zero and full current to the coils. These results are compared with predictions based on earlier tests.

42431 **Design and testing of electrical insulation for superconducting coils.** Schwenterly, S.W. (Oak Ridge National Lab., TN (USA)). pp 271-281 of Advances in cryogenic engineering. Volume 33. Fast, R.W. (ed.). New York, NY; Plenum Press (1988). (CONF-8706125—). Contract AC05-84OR21400.

From Cryogenic engineering conference; St. Charles, IL, USA (14 Jun 1987).

The dielectric properties of liquid and gaseous helium and nitrogen, vacuum, and solid insulation materials are summarized and reviewed. The influence of electrode geometry on breakdown voltage is discussed and features that require special care are pointed out. Appropriate room-temperature high-voltage testing is considered. The implications for coil insulation design of a new class of superconductors that can operate at temperatures approaching 77 K are examined.

42432 **Mirror fusion test facility cryogenic system - performance, management approach, and present equipment status.** Slack, D.S.; Chronis, W.C. (Lawrence Livermore National Lab., CA (USA)). pp 585-589 of Advances in cryogenic engineering. Volume 33. Fast, R.W. (ed.). New York, NY; Plenum Press (1988). (CONF-8706125—). Contract W-7405-ENG-48.

From Cryogenic engineering conference; St. Charles, IL, USA (14 Jun 1987).

The cryogenic system for the MFTF is a helium refrigeration system that proved to be successful and cost effective. All operating objectives were met while remaining within a few percent of the initial cost and schedule plans. The management approach used at MFTF is assessed. Manpower levels, extent and type of industrial participation, and subcontractor specifications and interactions are reviewed along with highlights of system testing, documentation, and operation.

42433 **Prevention of the current-quench phase of a major disruption in a tokamak reactor.** Miller, J.B. Knoxville, TN; Univ. of Tennessee (1987). 207p. University Microfilms Order No. 87-13,470.

Thesis (Ph. D.).

The 2-D Tokamak Simulation Code written by the Princeton Plasma Physics Laboratory was joined to a 3-D eddy-current code, which models periodic torus sectors. The combined system was found to be an efficient and accurate method for modeling the plasma/eddy current interaction during a major disruption. For modeling large highly compartmentalized structures, artificially increasing the self-inductance and limiting the mutual inductance of current elements were necessary to enhance numerical stability. Even with these modifications, a slowly growing instability made the results unreliable after 58 ms. This model was used to demonstrate prevention of the current quench phase of a major disruption in INTOR. The average plasma temperature was reduced to 150 eV over 3 ms. The (outboard) breeding blanket structure was constructed of CuBeNi and was electrically connected between torus sectors. Disruption recovery coils were provided inboard of the inboard shield (linking the toroidal field coils). It was necessary to supply to these coils a total of 500 MW for 0.6 s and to reheat the plasma to full beta in 6 s. The calculation shows a method of recovery from the most severe disruption probable. Determining the severity of the disruption from which recovery would be cost effective is beyond the scope of this study.

42434 **Edge plasmas and plasma/wall interactions in an ignition-class reversed field pinch.** Werley, K.A.; Bathke, C.G.; Krakowski, R.A. (Los Alamos National Lab., Los Alamos, NM (US)). pp 1414-1418 of Proceedings of the 12th symposium on fusion engineering. Piscataway, NJ; IEEE Service Center (1987). (CONF-871007—).

From 12. symposium on fusion engineering; Monterey, CA, USA (12 Oct 1987).

A range of limiter, armor, and divertor options are examined as a means to minimize plasma/wall interactions for a high-power-density, ignition-class reversed field pinch. An open, toroidal-field divertor can operate at maximum powers, while isolating the core plasma from impurities and protecting the wall.

42435 **Systems code comparison of internal and external pf coil CITs.** Galambos, J.D.; Strickler, D.J.; Peng, Y.K.M. (Fusion Engineering Design Center, P.O. Box Y, Oak Ridge, TN (US)). pp 1434-1437 of Proceedings of the 12th symposium on fusion engineering. Piscataway, NJ; IEEE Service Center (1987). (CONF-871007—).

From 12. symposium on fusion engineering; Monterey, CA, USA (12 Oct 1987).

System studies are performed to examine the tradeoffs of placing the poloidal field (PF) coils external to the toroidal field (TF) coils or internal to the TF coils in Compact ignition Tokamaks (CITs). This study compares the size requirements for internal and external PF CIT options having the same performance levels and compares performance capabilities of internal and external CITs of the same size. The authors find that the internal PF systems are slightly smaller (about 5 cm) than comparable-performance external PF CITs. The primary difference in the radial builds of the internal and external CITs results from the movement of the ohmic heating (OH) solenoid. At the same major radius, the all-internal PF case can achieve about 10% larger field on axis (B) levels (a physics performance parameter) than the external PF CIT. The power supply requirements are similar for the internal and external cases with equivalent performance. However, for the internal PF CIT, the power supply requirements are dominated by the TF coil (90%), whereas for the external PF coil case, the TF and PF coil circuits have roughly equal contributions to the power supply requirements.

42436 **Potential applications of high temperature superconducting magnets to fusion engineering.** Vold, E.L.; Blanchard, J.P.; Cooke, P.I.H.; Grotz, S.P.; Kessel, C.E.; Tynan, G. (Institute for Plasma and Fusion Research, Dept. of Mechanical, Aerospace, and Nuclear Engineering, UCLA, Los Angeles, CA (US)). pp 1408-1413 of Proceedings of the 12th symposium on fusion engineering. Piscataway, NJ; IEEE Service Center (1987). (CONF-871007—).

From 12. symposium on fusion engineering; Monterey, CA, USA (12 Oct 1987).

Recent advances in high temperature and high field superconductor technology are expected to have a major influence on fusion reactors. Improvements are examined in D-T toroidal systems, alternative fuel cycles, and the possibility of fusion driven space propulsion. The advantage of high magnetic (B) fields for fusion reactors is based upon scaling considerations that the fusion power density is proportional to B/sup 4/ in a beta limited system. Ohmic ignition of a tokamak is more likely in high fields because the ohmic power density scales as B/sup 2/. Following a review of recent experimental data on high temperature superconductors (SCs) the authors postulate the design parameters for high field SC magnet coils, with magnet operating temperatures of 30-40 K, high field, B≧20T, and modest current density values, —3 x 10/sup 7/ A/m/sup 2/. The authors find that coil stresses limit the current density for these high B field coils.

42437 **Magnetically swept open divertor concept.** Leuer, J.A.; Wesley, J.C. (GA Technologies Inc., P.O. Box 85608, San Diego, CA (US)). pp 1378-1381 of Proceedings of the 12th symposium on fusion engineering. Piscataway, NJ; IEEE Service Center (1987). (CONF-871007—).

From 12. symposium on fusion engineering; Monterey, CA, USA (12 Oct 1987).

Thermal power output from an ignited plasma will result in heat loads far in excess of those encountered in present tokamak experiments. The thermal problems associated with these heat loads are exacerbated by the physics requirement for operating the plasma in a diverted configuration. Highly contoured divertor plates are required to absorb the heat loads using the inertial cooling technique. This strategy requires precise plasma shaping and position control and greatly decreases the range of plasma shapes which can be accommodated in the device. Alternatively, the separatrices can be magnetically swept across simple geometry divertor plates, spreading the heat load and adding to the configurational flexibility of the device. In this paper scoping calculations are presented on the thermal response of a flat divertor plate to this sweeping motion. Substantial improvement in heat load capability can be achieved relative to a static configuration. In particular, the direction of motion is important for highly skewed heat flux distributions typical of tokamak devices. Simple scaling laws are presented and the results are applicable to the next generation ignition devices.

42438 TFTR diagnostic modifications required for D-T operation. Rocco, R.E.; Dudek, L.E. (Ebasco Services Inc., c/o PPPL, P.O. Box 451, Princeton, NJ (US)). pp 1528-1531 of Proceedings of the 12th symposium on fusion engineering. Piscataway, NJ; IEEE Service Center (1987). (CONF-871007—).

From 12. symposium on fusion engineering; Monterey, CA, USA (12 Oct 1987).

The planned D-T operation of the TFTR machine requires modifications to diagnostic equipment. This paper discusses the engineering approach taken to define and initiate the required modifications and presents an overview of those deemed significant. Diagnostic modifications are due to one or more of four primary requirements which are discussed in detail. The igloo presented the most obvious need for diagnostic modification; the relatively thick wall sections proposed for installation in the immediate vicinity of major diagnostic equipment areas required, in many cases, a need to move diagnostic equipment and to provide for an efficient and cost effective means of penetrating the wall. A discussion of the radiation hardening studies is included. A description is presented of the studies which were conducted to establish the operating reliability of diagnostic components for the purpose of defining the diagnostic changes necessary to meet the limited access requirements. Included are descriptions of the data base which was developed for the task. All diagnostic modifications are fully defined in a controlled document which addresses each diagnostic at each of the twenty machine bays. Particular attention was given to identifying items of work that could be accomplished early in the modification effort to limit the amount of work required at higher machine radiation levels and also to provide more time to recertify modified or displaced components.

42439 TFTR DT plan summary. Kungl, D. (Princeton Plasma Physics Lab., Princeton Univ., P.O. Box 451, Princeton, NJ (US)). pp 1516-1519 of Proceedings of the 12th symposium on fusion engineering. Piscataway, NJ; IEEE Service Center (1987). (CONF-871007—).

From 12. symposium on fusion engineering; Monterey, CA, USA (12 Oct 1987).

This paper describes the plans to prepare TFTR for Deuterium-Tritium (DT) fueled experimental operations. Factors that are important in the preparation effort are: total neutron production of 3 x 10/sup 21/ in the CY 90 DT experimental program; design objective radiation dose of 10 mRem/year at the site boundary; maintenance and repair work will be limited after DT experiments have started, machine hardware, particularly components inside the igloo shielding, must be highly reliable. Included in the plan are both internal and external manipulators to perform limited tasks within the TFTR torus and around the exterior of the machine. Some hardware on TFTR, particularly the neutral beams and carbon tiles, will be modified to accommodate use of the manipulators. Preparatory work will be performed in parallel with experimental operations with the majority of the installation work occurring during the CY 88 and CY 89 shutdowns. Experimental operations plans are such that machine activation will be at or below the level that safely permits hands-on work at the machine during shutdowns.

42440 TIBER thermal stability and burn control. Sager, G.T.; Miley, G.H. (Fusion Studies Lab., Univ. of Illinois, 103 South Goodwin Avenue, Urbana, IL (US)). pp 1457-1460 of Proceedings of the 12th symposium on fusion engineering. Piscataway, NJ; IEEE Service Center (1987). (CONF-871007—).

From 12. symposium on fusion engineering; Monterey, CA, USA (12 Oct 1987).

Plasma thermal stability and burn control for TIBER-II was studied. Following a systematic view of possible burn control methods, proportional control via refueling and additional heating was selected, assuming a near term development path (i.e., conservative physics). Four heating sources are considered: neutral beam current drive; lower hybrid current drive; and independent electron or ion cyclotron frequency heating systems. The burning plasma is described by a system of time-dependent, profile averaged, O-D differential equations representing the evolution of the N/sub i/, T/sub i/, and T/sub c/. Cases include: Q = 5 (Q = P/sub fus//P/sub aux/), steady-state drive (baseline case); Q = 12, inductively driven with lower hybrid sustainment during OH resent; and Q = ∞ inductively driven case. For, Q = 5 and Q = 12, the plasma is instrinsically stable while the Q = ∞ is unstable. Various control mechanisms and design implications are discussed.

42441 Disruption control in tokamak reactors by electron-cyclotron current drive. Smith, G.R.; Logan, B.G.; Kritz, A.H.; White, R.B. (Lawrence Livermore National Lab., Livermore, CA (US)). pp 1454-1456 of Proceedings of the 12th symposium on fusion engineering. Piscataway, NJ; IEEE Service Center (1987). (CONF-871007—).

From 12. symposium on fusion engineering; Monterey, CA, USA (12 Oct 1987).

Launch scenarios for electron-cyclotron power into TIBER-II equilibria are presented. The power is absorbed outside the q = 2 flux surface, and the driven current significantly modifies the current profile, which may serve to suppress tearing-mode instabilities and prevent disruptions. A feedback-stabilization scheme may suppress the instabilities with very modest incident power. One of the launch scenarios is also effective for heating the plasma core during the startup phase.

42442 An ohmic heating plasma current control method. Yang, T.F.; Luan, G.S. (Massachusetts Institute of Technology, Plasma Fusion Center, Cambridge, MA (US)). pp 1442-1445 of Proceedings of the 12th symposium on fusion engineering. Piscataway, NJ; IEEE Service Center (1987). (CONF-871007—).

From 12. symposium on fusion engineering; Monterey, CA, USA (12 Oct 1987).

It was found that the plasma current profile is not necessarily centrally peaked as conventionally predicted by MHD equilibrium calculations. A time dependent pure inductive and a dynamic MHD calculation indicate that multiple peaking provides can be obtained by proper design of the OH coil, the divertor coil and the EF coil, and by the programming of the pulse time length, fueling and heating sequence. Multiple peaking of current profiles is desirable because it has a stabilizing effect on ballooning modes for high B/sub t/ plasma.

42443 TIBER II parameters with neutral beams at high energies. Devoto, R.S.; Fenstermacher, M.; Papanikolaou, P. (Lawrence Livermore National Lab., P.O. Box 5511, L-644, Livermore, CA (US)). pp 1438-1441 of Proceedings of the 12th symposium on fusion engineering. Piscataway, NJ; IEEE Service Center (1987). (CONF-871007—).

From 12. symposium on fusion engineering; Monterey, CA, USA (12 Oct 1987).

The baseline neutral beam energy for TIBER II was chosen to be 500 keV consistent with the use of near term dc acceleration technology. Adequate penetration to the axis for core current drive in larger ETR devices requires higher beam energies. However, beam instabilities may limit the current drive efficiency at high energy to lower values than predicted classically. The characteristics of TIBER II and a device with 4.5 major radius as functions of beam energy are presented.

42444 MHD power generation using controlled plasma of the tokamak fusion reactor divertor. Denno, K. (New Jersey Institute of Technology, Newark, NJ (US)). pp 1358-1361 of Proceedings of the 12th symposium on fusion engineering. Piscataway, NJ; IEEE Service Center (1987). (CONF-871007—).

From 12. symposium on fusion engineering; Monterey, CA, USA (12 Oct 1987).

Using the controlled divertor plasma a new tensorial form for the plasma electrical conductivity is secured, followed by obtaining design criteria for the induced current density, power output and efficiency for the ideal MHD-generator. Then with consideration for end-effects of the MHD generator channel and with controlled tensorial electrical conductivity due to perfect divertor role, improved design conditions for the induced current density, power output and efficiency with conditions for peak limits have been established. Also, under intensive applied magnetic field and perfect divertor role including total removal of impurities from divertor channel, the principle of magnetic boundary layer in securing voltage induced in the MHD generator is verified.

42445 **High resolution time-resolved x-ray microscope for inertial confinement fusion (ICF) target dynamics experiments.** Ellis, R.J.; Deane, D.J.; Kilkenny, J.D.; Levesque, R.A.; Phillion, D.W. (Univ. of California, Lawrence Livermore National Lab., P.O. Box 5508, L-479, Livermore, CA (US)). pp 1500-1503 of Proceedings of the 12th symposium on fusion engineering. Piscataway, NJ; IEEE Service Center (1987). (CONF-871007—).

From 12. symposium on fusion engineering; Monterey, CA, USA (12 Oct 1987).

A versatile x-ray microscope diagnostic has been built to perform target dynamics experiments on the Nova Ten Beam target irradiation facility. This system is based on Wolter's axisymmetric focusing scheme. An alignment system is described which provides for both quick and accurate alignment of the x-ray optic. Results are presented showing the system resolution and accuracy of alignment. Images from target dynamics experiments are also presented.

42446 **The ground-fault detection system for DIII-D.** Scoville, J.T.; Petersen, P.I. (GA Technologies Inc., P.O. Box 85608, San Diego, CA (US)). pp 1532-1535 of Proceedings of the 12th symposium on fusion engineering. Piscataway, NJ; IEEE Service Center (1987). (CONF-871007—).

From 12. symposium on fusion engineering; Monterey, CA, USA (12 Oct 1987).

This paper presents a discussion of the ground-fault detecting systems on the DIII-D tokamak. The subsystems that must be monitored for an inadvertent ground include the toroidal and poloidal coil systems, the vacuum vessel, and the coil support structures. In general, one point of each coil is tied to coil/power supply ground through a current limiting resistor. For ground protection the current through this resistor is monitored using a dynamically feedback balanced Hall probe transducer from LEM Industries. When large inductive currents flow in closed loops near the the tokamak, the result is undesirable magnetic error fields in the plasma region and noise generation on signal cables. Therefore, attention must be paid to avoid closed loops in the design of the coil and vessel support structure. For DIII-D a concept of dual insulating breaks and a single-point ground for all structure elements was used to satisfy this requirement. The integrity of the support structure is monitored by a system which continuously attempts to couple a variable frequency waveform onto these single-point grounds. The presence of an additional ground completes the circuit resulting in current flow. A Rogowski coil is then used to track the unwanted ground path in order to eliminate it. Details of the ground fault detection circuitry, and a description of its operation will be presented.

42447 **Alpha ash effect and control in TIBER II.** Hu, S.C.; Miley, G.H. (Fusion Studies Lab., Univ. of Illinois at Urbana-Champaign, 214 Nuclear Engineering Lab., 103 S. Goodwin Ave., Urbana, IL (US)). pp 1461-1464 of Proceedings of the 12th symposium on fusion engineering. Piscataway, NJ; IEEE Service Center (1987). (CONF-871007—).

From 12. symposium on fusion engineering; Monterey, CA, USA (12 Oct 1987).

Alpha ash buildup effect in TIBER-type plasma performance is examined by using a steady-state model. With Kaye-Goldston scaling, the results show that at $T \approx 16$ KeV the ignition window constrained by the Murakami density limit and 0.75 Troyon beta limit (i.e. the auxiliary power = 0) closes with — 5% ash concentration and the driven window (i.e. the auxiliary power not equal to 0) closes with — 14% ash concentration. Clearly then, a steady-state reactor like TIBER II will require some active ash control. Several potential control methods are suggested and a brief discussion of these methods is also given.

42448 **MTX facility and machine grounding plan.** Bell, H.H.; Rice, B.W.; Petersen, D.E.; Herrera, C.H. (Lawrence Livermore National Lab., P.O. Box 808, L-635, Livermore, CA (US)). pp 1465-1468 of Proceedings of the 12th symposium on fusion engineering. Piscataway, NJ; IEEE Service Center (1987). (CONF-871007—).

From 12. symposium on fusion engineering; Monterey, CA, USA (12 Oct 1987).

A key issue in the design of fusion research experiments and their related facilities is the control of ground currents. Because of the large magnetic field, high voltages and high currents present in most of these installations, it is essential to avoid ground loops, and to control ground currents during both normal operations and fault conditions. The Microwave Tokamak Experiment (MTX) was installed in an existing building. The building was modified to add a new vault with shield walls to house the experiment. Experimental experience with other tokamaks has indicated the necessity of correctly isolating and grounding "utility" structures such as tray, conduit, pipe, and supports for diagnostics and the machine. This paper describes the grounding policy that was developed for MTX. The vault area was divided into zones, and each of the four walls was treated as a separate grounding area. Cable runs and magnet buss bars were run into the machine radially. The paper also describes the steps taken to isolate diagnostic signals and power for pumps and instruments. The paper outlines some of the field calculations used to predict problem areas, and to reveal voltage isolation levels that were required. The paper includes the active ground fault detection system used to insure the integrity of the ground system.

42449 **Design considerations of modular pump limiters for large tokamaks.** Uckan, T.; Klepper, C.C.; Mioduszewski, P.K. (Oak Ridge National Lab., Oak Ridge, TN (US)). pp 1402-1407 of Proceedings of the 12th symposium on fusion engineering. Piscataway, NJ; IEEE Service Center (1987). (CONF-871007—).

From 12. symposium on fusion engineering; Monterey, CA, USA (12 Oct 1987).

Long-pulse (>10-s) and high-power (>10-MW) operation of large tokamaks requires multiple limiter modules for particle and heat removal, and the power load must be distributed among a number of modules. Because each added module changes the performance of all the others, a set of design criteria must be defined for the overall limiter system. The relationship between individual modules must also be considered from the standpoint of flux coverage and shadowing effects. This paper addresses these issues and provides design guidelines. Parameters of the individual modules are then determined from the system requirements for particle and power removal. Long-pulse operation of large tokamaks requires that the limiter modules be equipped with active cooling. At the leading edge of a module, the cooling channel determines the thickness of the limiter blade (or head). A model has been developed for estimating the system exhaust efficiency in terms of the parameters of the leading edge (i.e., its thickness and the design heat flux) in terms of given device parameters and the power load that must be removed. The impact on module design of state-of-the-art engineering technology for high heat removal is discussed. The choice of locations for the modules is also investigated, and the effects of shadowing between modules on particle and power removal are examined. The results are applied to the Tore Supra tokamak. Conceptual design parameters of the modular pump limiter system are given.

42450 **The LPX facility.** Ginn, J.W.; Hendricks, D.N.; Clark, M.C.; Buttram, M.T. (Sandia National Labs., Albuquerque, NM (US)). pp 98 of The 1987 IEEE international conference on plasma science (Abstracts). Piscataway, NJ; IEEE Service Center (1987). (CONF-870651—).

From IEEE international conference on plasma science; Crystal City, VA, USA (1 Jun 1987).

The LPX (Long Pulse eXperiment) facility is designed to deliver 200 kilojoules in a pulse duration of 1 μs directly to a load without the use of a pulse-forming line. The pulse is generated by a 16-stage Marx generator with a total charged capacitance of 42 μF and a maximum erected open-circuit voltage of 1.6 MV. The load consists of a magnetically-insulated, line-limited, saturated parapotential-flow diode. In order to provide the pulsed power for LPX, a modification has been made to a Marx generator of the type used to drive the PBFA accelerator. The Marx consists of 32 capacitors, each of which has a value of 1.3 μF and a voltage rating of 100 kV. At full charge, the stored energy is therefore 210 kJ. For the present application, the Marx is configured in sixteen stages of 2 capacitors per stage, resulting in a total erected capacitance of 160 nF. The overall inductance of the Marx is estimated to be 4 μH.

The output of the Marx is connected directly to the load through a feed section, the inductance of which is approximately 1 μH.

42451 **Spectroscopic studies of a laser-produced carbon plasma in the near and extreme ultraviolet.** Iglesias, E.J. College Park, MD; Univ. of Maryland (1987). 138p. University Microfilms Order No. 87-25,512.

Thesis (Ph. D.).

This work deals mainly with the line emission from C V and C VI ions in a plasma produced when a ruby laser pulse (power density $> 10^{12}$ W/cm^2) is focused onto a polyethelene target under vacuum. The plasma emission was temporally and spatially resolved using near ultraviolet (NUV) and extreme ultraviolet (XUV) diagnostics. In the NUV, line profiles of the $\Delta n = O$, $n = 2$ transitions of C V (2271, 2277, and 3526 A) and then $n = 7 \rightarrow 6$ transition of C VI (3434 A) at 3 mm from the target surface were measured. The $\Delta n = O$ measured profiles resulted in widths larger than what could be estimated from considering the thermal Doppler broadening, motional Doppler shifts and Stark broadening from the different emission regions of the plasma. In the XUV region, profiles of members (Ly/sub β/, Ly/sub δ/) of the Lyman series of (H/sub α/, H/sub β/) of the Balmer series of C VI close to the target surface, as well as the helium-like and hydrogen-like recombination continua were measured. The width of H/sub β/ and Ly/sub δ/ provided an estimated electron density (10^{20} cm^{-3}). From the recombination continuum, an electron temperature ($\sim$ 60 eV), also near the target surface was obtained.

42452 **Numerical and theoretical investigations of Z-pinch plasma channels for light-ion-beam inertial-confinement fusion.** Watrous, J.J. Madison, WI; Univ. of Wisconsin (1986). 336p. University Microfilms Order No. 86-20,918.

Thesis (Ph. D.).

Z-pinch plasma channels are investigated as beam-transport channels for light-ion-beam inertial-confinement fusion. The channels are intended to provide a high-efficiency propagation path for the ion beams as they travel a distance of several meters from the extractor diodes to the target. The channels must satisfy several conditions to be useful as beam-transport channels: their azimuthal magnetic field must be strong enough to confine the intense beams to small radius, and the mass density in the channel must be great enough to provide a high degree of current neutralization for the beams. This research uses numerical simulations and theoretical models to investigate how the radial evolution of the z-pinch plasma channel can be controlled to satisfy these conditions. A theoretical model of the injection of an ion beam into the end of a channel is used to derive a condition that the channel must meet to confine a given amount of ion beam power to a certain radius. This condition states that the peak magnetic field times the cube of the channel's radius must exceed a certain value that depends on the ion beam properties to be able to confine a given amount of ion beam power. Numerical investigations of the blast-wave expansion of the channel were used to develop a new blast-wave. This model predicts that by properly changing the initial mass density and the peak discharge current, channels with identical hydrodynamic behaviors can be created.

99 GENERAL AND MISCELLANEOUS

42453 **(DOE/ER—0369) Guide for the preparation of proposals for the Pre-Freshman Engineering Program, PREP-1989.** (USDOE Office of Energy Research, Washington, DC. University and Industry Programs Div.). Aug 1988. 29p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88012453/JAW.

This guide details the preparation of proposals for the Pre-Freshman Engineering Program 1989 sponsored by the US Department of Energy, Division of University and Industry Programs, Office of Energy Research. The guide covers deadlines, application format, conditions, and requirements of the program. (JF)

42454 **(DOE/IG—0252) Inspection of the handling of selected chemicals at Lawrence Livermore National Laboratory.** (Department of Energy, Washington, DC (USA). Office of Inspector General). 19 Feb 1988. 19p.

The subject report is provided to inform of our findings and recommendations as a result of our inspection, and to give an opportunity to comment. The purpose of this inspection was to examine the potential for manufacture and/or diversion of 49 selected chemicals which were either controlled drugs or precursors that could be illegally used for the manufacture of such drugs, and to determine whether controls in place were adequate to detect misuse of these selected chemicals.

42455 **(DOE/MA—0331-1) Department of Energy audit resolution, followup and internal control review activity: Quarterly management report as of March 31, 1988.** (USDOE, Washington, DC). Jun 1988. 55p. NTIS, PC A04/MF A01;1; GPO Dep. Order Number DE88011902/JAW.

This report provides information to the Department of Energy (DOE) management on the status of audit followup, General Accounting Office (GAO), Inspecter General (IG) and internal control system activity for the quarter ended March 31, 1988. It is based on information accumulated and maintained by the Audit Liaison Division of the Controller's Office pursuant to DOE 2300.1A (draft 8/83) (AUDIT COMPLIANCE AND FOLLOWUP), 2340.1B (COORDINATION OF GENERAL ACCOUNTING OFFICE ACTIVITIES), 2320.2 (ESTABLISHMENT OF DEPARTMENTAL POSITION ON INSPECTOR GENERAL REPORTS) and 1000.3A (INTERNAL CONTROL SYSTEMS).

9901 Management

REFER ALSO TO CITATION(S) 39670, 42539

42456 **(DOE/METC—88/6089) Morgantown Energy Technology Center Publications List, FY 1987.** Brown, W.A.; Pasini, S.E. (USDOE Morgantown Energy Technology Center, WV). Feb 1988. 94p. NTIS, PC A05/MF A01;1; GPO Dep. Order Number DE88001025/JAW.

This Publications List includes the scientific and technical reports and papers authored by the Morgantown Energy Technology Center (METC) staff as well as those written by METC contractors during fiscal year 1987. The reports and papers are arranged by METC areas of expertise: Arctic and Offshore, Components, Environment, Fluidized-Bed Combustion, Fuel Cells, Gas Stream Cleanup, Gasification, Heat Engines, Instrumentation and Control, Low-Rank Coal, Oil Shale, Tar Sands, Unconventional Gas and Enhanced Oil Recovery, Underground Coal Gasification, and Crosscutting Technologies. The reports are subarranged by report numbers from the Energy Data Base. Author/corporate author, report number, order number, and title indexes follow.

42457 **(KFK—4225) List of scientific publications of the Karlsruhe Nuclear Reseach Centre for the year 1986.** (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.)). May 1987. 143p. (In German). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88752673/JAW.

This report contains the titles of the publications which appeared during the year 1986. Lectures which have not been printed yet are listed separately from the literature. All the patents awarded or published in 1986 are given; i.e. patents and publications of patents. Summarising lectures and practical instructions from the courses at the College for Nuclear Technology are not included in the list. The list of publications is arranged according to Institutes. Among the projects, only the published project reports and publications by members of the staff of the project are listed. The publications printed at the Nuclear Research Centre from the research and development projects of the Manufacturing Technique Project (PFT) and the project on the 'European Research Centre for Measures for Keeping the Air Clean' (PEF), which are being carried out by the Nuclear Research Centre in collaboration with firms and institutions, are also included in the list. The list also contains publications by the external office of the West German Institute of Food resident in the Nuclear Research Centre. The last chapter of the list contains publications on guest experiments at the Nuclear Research Centre. The list has an alphabetical index, which gives page and registry numbers.

42458 (ORNL/TM—10136/R2) Instrumentation and Controls Division maintenance management plan: Revision 2. Miller, D.R. (Oak Ridge National Lab., TN (USA)). Jul 1988. Contract AC05-84OR21400. 17p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88013134/JAW.

This report documents the policies and procedures of the Maintenance Management Department in the Instrumentation and Controls Division at Oak Ridge National Laboratory, and identifies applicable DOE guidelines and requirements. This report also contains an overview of a data base program, Maintenance Accountability Jobs and Inventory Control (MAJIC), a work mangement system developed in-house for the collection of data on work requests, work assignments, work report summaries, euipment records, and manpower and materials control. The MMD MAJIC data base program includes a cost accumulation and reporting system for cost control. It has the capability to generate summary reports on preventative maintenance and calibration activities. The MMD policies and procedures described are designed to comply with applicable ORNL programs such as employee safety, operational safety requirements, quality assurance, reactor personnel qualification and training, and maintenance of DOE-owned reactors.

42459 (UCRL—98333) Challenges in product definition management. Trost, S.R. (Lawrence Livermore National Lab., CA (USA)). 14 Apr 1988. Contract W-7405-ENG-48. 5p. (CONF-880719—6). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88009050/JAW.

From ASME international computers in engineering conference and exhibition; San Francisco, CA, USA (31 Jul 1988).

Lawrence Livermore National Laboratory (LLNL), together with other DOE agencies, is participating in a multi-year program to provide full CIM capability across four design laboratories and seven manufacturing plants. We have gained substantial experience in computer aided design, secure electronic transmission using the IGES standard, and transferring designs to our manufacturing partners. Two major shortcomings exist in current implementations: 1) IGES is insufficient to meet our needs and 2) database management and archival technologies require much more effort. We are addressing the first concern by active participation in development of the Product Definition Exchange Standard (PDES). We are also actively pursuing solutions to the second problem; we have learned that the ultimate development and application of PDES will affect data base management and archival. New challenges emerge in an electronic environment. Among these are the merging of corporate and engineering databases, lack of industry standards, many new archival technologies including optical and magnetic media, and different data formats (raster, IGES, native CAD, pilot). We must learn to manage 3 dimensional geometric data in addition to flat drawings. Producing new standards to help promote these technologies is vital. We are approaching system design and implementation by application of a multi-layer model of the drafting and records environment. This logical model lets us break down requirements into easily understood and managed entities. Included are views of the drafter, drafting room, project, and entire laboratory. This paper discusses this model and implications for other organizations. 5 refs., 4 figs.

9902 Mathematics And Computers

REFER ALSO TO CITATION(S) 39249, 39888, 39900, 39901, 39917, 39921, 39922, 39923, 39924, 39925, 39926, 39927, 39928, 39929, 39930, 39931, 39932, 39933, 40921, 42535

42460 (AD-A—189172/0/XAB) Evaluation of a parallel chart parser. Project Memo. Grishman, R.; Chitrao, M. (New York Univ., NY (USA). Courant Inst. of Mathematical Sciences). Sep 1987. 14p. (PROTEUS-M—10). NTIS, PC A03/MF A01.

A parallel implementation of a chart parser is described for a shared-memory multiprocessor. The speedups obtained with this parser were measured for a number of small natural-language grammars. For the largest of these, part of an operational question-answering system, the parser ran 5 to 7 times faster than the serial version.

42461 (AD-A—189682/8/XAB) Simulation of fault tolerance in a Hypercube arrangement of discrete processors. Master's thesis. Zilberstein, G. (Air Force Inst. of Tech., Wright-Patterson AFB, OH (USA). School of Engineering). Dec 1987. 86p. (AFIT/GSO/ENG—87D-1). NTIS, PC A05/MF A01.

The purpose of this study was to implement a technique for fault-tolerant parallel computation on the Intel Corporation's Hypercube computer. This work was motivated by the recent progress in parallel-computation and neural-network techniques. This study focuses on the implementation of one particular type of parallel-processing architecture on the Intel Hypercube. The architecture in question is known as the cube-connected cycle (CCC). This architecture is used as a basis for a reconfiguration scheme known as reconfigurable cube-connected cycles. The aim of this reconfiguration is to build a parallel computing system with fault tolerance capability. Implementation of this technique on the Intel Hypercube was by simulation. The loading of only part of the hypercube available nodes, holding the remaining nodes in reserve was accomplished, followed by a simulation of the replacement of a deactivated node with a spare node. Conclusions are reached regarding the suitability of the Intel machine for fault-tolerance experiments versus the rapid computation for which it was designed. Recommendations are made regarding the next logical steps in continuation of the work presented in this study.

42462 (AD-A—189844/4/XAB) Methodolgy, based on analytical modeling, for the design of parallel and distributed architectures for relational data-base query processors. Doctoral thesis. Kearns, T.G. (Air Force Inst. of Tech., Wright-Patterson AFB, OH (USA). School of Engineering). Dec 1987. 351p. (AFIT/DS/ENG—87-1). NTIS, PC A16/MF A01.

The design of faster relational data-base query processors to improve the data-retrieval capability of a data-base was the goal of this research. The emphasis was on evaluating the potential of parallel implementations to allow use of multiprocessing. First, the theoretical properties of applying relational operations to distributed data were considered to provide an underlying data distribution and parallel-processing environment model. Next, analytical models were constructed to evaluate various implementations of the select, project, and joint relational operations and the update operations of addition, deletion, and modification for a range of data structures and architectural configurations. To simulate the performance of the query processor for all cases, the individual operator models needed to be extended for complex queries consisting of several relational operations. A solution to modeling multi-step queries was the use of a general normal form to express a query. This normal-form query tree used combined operations to express relational-algebra equivalent queries in a standard form. This standard-tree form was then used to construct analytical models for multi-step queries. These models provide the capability to simulate the potential of different forms of parallelism in solving complex queries. The analysis of results of the analytical models presents a logical design for a multiprocessor query processor. This logical query processor using multiple processors and employing parallelism illustrated the potential for an improved query processor when the analytical-model results of complex queries were compared to a benchmark of some current data-base systems.

42463 (AD-A—190076/0/XAB) Study of microcomputer-based real-time programmable optical-signal processor and application. Final report, 1 August 1986-30 September 1987. Yu, F.T. (Pennsylvania State Univ., University Park (USA). Dept. of Electrical Engineering). 18 Nov 1987. 129p. NTIS, PC A07/MF A01.

The author in this period, developed a microcomputer-based optical linear-transformation processing technique. The technique utilizes a systolic-array processing method to perform various types of linear transformations, such as discrete Fourier transformation, discrete Hilbert transformation, discrete chirp-Z transformation and many others. By partially parallel addressing two magneto-optic spatial light modulators (MOSLM), this proposed system would offer high-speed and parallel-processing capability of optics and programmability of microcomputer. This research shows that a

color liquid-crystal television (LCTV) can be used for color pattern recognition. The grid structure of the display panel together with a specially designed color filter provides spatially isolated polychromatic spectra to enable polychromatic signal detection. A serious drawback was found of the color LCTV which is the lack of space invariance, even after it has been immersed in a liquid gate. This drawback is primarily due to the inherent color filter in the liquid crystal display and the phase modulation by liquid-crystal molecules. A quantitative investigation of space variance of the LCTV, especially the color LCTV, is currently being studied.

42464 **(AD-A—190267/5/XAB) Expert system supplemented by a data-base management system serving as an electrical-distribution-system engineering aid. Master's thesis.** Long, R. (Washington Univ., Seattle (USA)). 1988. 77p. NTIS, PC A05/MF A01.

Electrical-distribution systems provide power to loads. Numerous individuals are involved in the design, operation, maintenance, and modification of these systems. Traditionally these individuals have relied on drawings, operations manuals, meter readings, and experience as primary resources in accomplishing these tasks. Emerging as a new resource is the Expert System. Expert Systems (ESs) are knowledge-based computer programs that provide assistance in domain-specific problem solving. They solve problems by duplicating human problem-solving methods, using deductive reasoning techniques in conjunction with factual information to analyze a problem and reach a solution. The required reasoning skills can be obtained by analyzing the problem-solving methods of human experts. Factual information can be organized as individual fact statements or, in the case of large systems, the information can be gathered and organized into data-base form by Data-Base Management Systems (DBMSs). The codification of these reasoning techniques and the factual information makes up the knowledge base of an ES. This thesis demonstrates an ES concerned with electrical-distribution-system connectivity problems. Connectivity concerns the paths for transferring power from sources to loads. Using DBMS data-base information, the ES analyzes how the distribution system provides loads with power. The ES additionally determines the effects of various system faults, such as line failures and the opening of circuit breakers. The results of the analysis includes determining which loads have lost service and which circuit breakers or lines have been rendered unusable.

42465 **(AD-A—190630/4/XAB) Programming environments for systolic arrays. Technical report.** Snyder, L. (Washington Univ., Seattle (USA). Dept. of Computer Science). Feb 1986. 24p. (TR—86-02-02). NTIS, PC A03/MF A01.

Although a systolic array is often thought of as a hard-wired device, there are many reasons to want to program systolic algorithms. In this paper the problem of providing an efficacious programming environment is addressed. The difficulties of programming complex parallel algorithms are shown to be reduced by using a new concept of a parallel program which maximizes the use of graphical abstractions and minimizes the need for symbolic text. This concept is illustrated by the Poker Parallel Programming Environment which, although designed for a broader class of algorithms, illustrates the main features that a programming environment specialized to systolic computation should have. In the event that the programming environment is for systolic arrays, the programs are parallel and thus impose additional demands on the system such as data formatting, management of multiple process sets, and the specification of data routings. Providing all of these facilities in a single integrated system requires a new concept of parallel program, which, although it is quite different from FORTRAN and PASCAL, is nevertheless easier to use for a systolic array than a conventional programming language. The key to achieving this simplicity is to use graphics so extensively that the resulting programs appear to be dynamic versions of the diagrams presented in textbooks.

42466 **(AD-A—190883/9/XAB) Program profiling in Cedar.** Malony, A. (Illinois Univ., Urbana (USA). Center for Supercomputing Research and Development). 17 Mar 1987. 42p. (CSRD—654). NTIS, PC A03/MF A01.

The goal of program profiling is to provide an accurate characterization of a program's behavior and performance. Program profiling can have several different meanings depending on the measurements of interest and the programming environment. Generally, profiling measurements are concerned with collecting information regarding the dynamic execution behavior of the program. The purpose is to help the user evaluate alternative implementations and to guide program optimizations. This paper presents an analysis of parallel program profiling for the Cedar multiprocessor and a preliminary functional specification of a parallel program profiling tool, CPROF. The standard UNIX profiling tools serve as a beginning design basis for CPROF and their basic functionality is discussed in Section 2. Section 3 describes the problems with parallel program profiling. In particular, profiling in the Cedar program execution environment is analyzed. The initial version of CPROF supports routine counting and timing functionality. The proposed CPROF implementation is presented in detail in Section 4. Profiling operations other than routine counting and timing are interesting for parallel programs. Section 5 briefly describes possible extensions of CPROF.

42467 **(AD-A—190885/4/XAB) VPC - a proposal for a vector-parallel C programming language. Report for 1 October 1986-30 September 1987.** Guarna, V.A. (Illinois Univ., Urbana (USA). Center for Supercomputing Research and Development). 30 Oct 1987. 32p. (CSRD—666). NTIS, PC A03/MF A01.

This paper proposes a definition for VPC, an extended C programming language for vector-parallel applications. VPC is a superset of the conventional C language that contains extensions for vector and parallel machines. New constructs and their semantics are presented, along with some discussion about potential problems that arise when extending C into the parallel domain. The reader is assumed to be familiar with the C programming language--this paper only describes those aspects of VPC that differ from the standard definition.

42468 **(AD-A—190887/0/XAB) Supercomputer programming environments. Report for 1 October 1986-30 September 1987.** Padua, D.A.; Guarna, V.A.; Lawrie, D.H. (Illinois Univ., Urbana (USA). Center for Supercomputing Research and Development). 30 Oct 1987. 31p. (CSRD—673). NTIS, PC A03/MF A01.

The quest to apply an ever-increasing amount of computing power to numerical applications has resulted in the evolution of a broad spectrum of ideas and implementations for high-performance computing systems. The architectural complexity of these high-performance systems typically requires special tools and techniques to achieve efficient utilization of available computational resources. These tools range from automatic restructuring and optimizing compilers to interactive debugging and performance-analysis systems. The programming environment for these systems must be general and adaptive, providing the appropriate level of assistance for users of varying levels of sophistication. This paper presents recent developments in supercomputer environments, and focuses in more detail on the Cedar Project which is currently under way at the University of Illinois Center for Supercomputing Research and Development. The Cedar Project consists of the construction of a prototype multiprocessor, restructuring compilers for the Fortran and C programming languages, and an integrated graphics-based programming environment intended to serve the needs of scientific applications users.

42469 **(AD-A—190910/0/XAB) Design and evaluation of fault-tolerant VLSI/WSI processor arrays. Final technical report, 1 July 1985-31 December 1987.** Fortes, J.A. (Purdue Univ., Lafayette, IN (USA)). 31 Dec 1987. 233p. NTIS, PC A11/MF A01.

This document is the final report of work performed under the project entitled Design and Evaluation of Fault-Tolerant VLSI/WSI Processor Arrays supported by the Innovative Science and Technology Office of the Strategic Defense Initiative Organization and administered through the Office of Naval Research under Contract No. 00014-85-k-0588. With the concurrence of Dr. Clifford Lau, the Scientific Officer for this project, this final report consists of reprints of publications reporting work performed under the project. In the attached list of publications are papers where

fault-tolerant systems for processor arrays are proposed and studied. Studies on algorithmic and software aspects relevant to the systems are also reported, as well as hardware and reconfigurability issues for fault-tolerant processor arrays.

42470 **(AD-A—191029/8/XAB) Two fundamental issues in multiprocessing. Technical report.** Iannucci, R.A.; Arvind. (Massachusetts Inst. of Tech., Cambridge (USA). Lab. for Computer Science). Oct 1987. 28p. (MIT/LCS/TM—330). NTIS, PC A03/MF A01.

Supersedes AD-A134 239.

A general-purpose multiprocessor should be scalable, i.e., show higher performance when more hardware resources are added to the machine. Architects of such multiprocessors must address the loss in processor efficiency due to two fundamental issues: long memory latencies and waits due to synchronization events. It is argued that a well-designed processor can overcome these losses provided there is sufficient parallelism in the program being executed. The detrimental effect of long latency can be reduced by instruction pipelining, however, the restriction of a single tread of computation in von Neumann processors severely limits their ability to have more than a few instructions in the pipeline. Furthermore, techniques to reduce the memory latency tend to increase the cost of task switching. The cost of synchronization events in von Neumann machines makes decomposing a program into very small tasks counter-productive. Dataflow machines, on the other hand, treat each instruction as a task, and by paying a small synchronization cost for each instruction executed, offer the ultimate flexibility in scheduling instructions to reduce processor idle time.

42471 **(AD-A—191327/6/XAB) Generalizing the structure of explanations in explanation-based learning. Doctoral thesis.** Shavlik, J.W. (Illinois Univ., Urbana (USA). Coordinated Science Lab.). Dec 1987. 291p. (UILU-ENG—87-2276). NTIS, PC A13/MF A01.

Explanation-based learning is a recently developed approach to concept acquisition by computer. In this type of machine learning, a specific problem's solution is generalized into a form that can later be used to solve conceptually similar problems. A number of explanation-based generalization algorithms were developed. Most do not alter the structure of the explanation of the specific problem - no additional objects nor inference rules are incorporated. Instead, these algorithms generalize by converting constants in the observed example to variables with constraints. However, many important concepts, in order to be properly learned, require that the structure of explanations be generalized. This can involve generalizing such things as the number of entities involved in a concept or the number of times some action is performed. For example, concepts such as momentum and energy conservation apply to arbitrary numbers of physical objects, clearing the top of a desk can require an arbitrary number of object relocations, and setting a table can involve an arbitrary number of guests. Two theories of extending explanations during the generalization process were developed, and computer implementations were created to computationally test these approaches. The Physics 101 system utilizes characteristics of mathematically-based problem solving to extend mathematical calculations in a psychologicalfy-plausible way, while the BAGGER system implements a domain-independent approach to generalizing explanation structures. Both of these systems are described and the details of their algorithms presented. An approach to the operationality/generality trade-off and an empirical analysis of explanation-based learning are also presented.

42472 **(AD-A—191432/4/XAB) Year of programming. Final technical report.** Browne, J.C.; Misra, J. (Texas Univ., Austin (USA). Dept. of Computer Sciences). 1987. 54p. NTIS, PC A04/MF A01.

The 1987 University of Texas Year of Programming was established early in 1986, in response to a proposal by Profs. Browne and Misra, with the following goals: 1) to advance the art and science of programming by bringing leading scientists together for discussions and collaboration; 2) to disseminate among leading practitioners the best of what has been learned about the theory and practice of programming; and 3) to provide critical research direction for the University Research Initiative in Formulation and Programming of Parallel and Distributed Computation. A small-scale workshop, involving about two dozen participants, met on the UT campus to bring together academic researchers and builders of real-time systems to enable researchers to assess their work's potential impact and to enable system builders to learn about current research and to influence its direction to advance the design of real-time systems. The workshop disclosed that there is a serious lack of communication between researchers and practitioners, but that recent advances in specification methodology, temporal logic, and scheduling theory may provide a theoretical groundwork for real-time-system design.

42473 **(AD-A—191581/8/XAB) NOSC (Naval Ocean Systems Center) advanced systolic array processor (ASAP). Professional paper for period ending August 1987.** Loughlin, J.P. (Naval Ocean Systems Center, San Diego, CA (USA)). Dec 1987. 11p. NTIS, PC A03/MF A01.

Design of a high-speed (250 million 32-bit floating-point operations per second) two-dimensional systolic array composed of 16-bit/slice microsequencer structured processors is presented. System-design features such as broadcast data flow, tag bit movement, and integrated diagnostic test registers are described. The software development tools needed to map complex matrix-based signal-processing algorithms onto the systolic-processor system are described.

42474 **(AD-A—191588/3/XAB) Neural networks for speech application. Professional paper for period ending October 1987.** Luse, S.A. (Naval Ocean Systems Center, San Diego, CA (USA)). Nov 1987. 8p. NTIS, PC A02/MF A01.

Pub. in Speech Technology, Vol. 4, 68-72(Oct/Nov 1987).

This is a general introduction to the reemerging technology called neural networks, and how these networks may provide an important alternative to traditional forms of computing in speech applications. Neural networks, sometimes called Artificial Neural Systems (ANS), have shown promise for solving problems that traditional algorithmic and AI (artificial intelligence) approaches have found difficult. The world's greatest supercomputer calculates Pi to thousands of decimal places in seconds using algorithmic techniques, but it may not ever be able to recognize a smiling human face when only a non-smiling version of this face is available for comparison. One reason for this is that computers process information serially, and an incredibly large number of serial steps are required to perform such a task. Therefore, even with the fastest computer, developing algorithms that can ignore unimportant differences in images and match-stored patterns with acceptable time delays is not an easy feat. The brain, on the other hand, processes information in a parallel fashion, distributing information and processing tasks throughout many neurons and their interconnections. ANS processors mimic this parallel structure and are able to outperform serial processors for certain tasks. They can also learn from their environment and are highly tolerant of internal failures.

42475 **(AD-A—191661/8/XAB) Alerting, explanation, and knowledge acquisition for a Naval threat-assessment expert system. Final technical report, October-December 1987.** Gadbois, L.E. (Naval Ocean Systems Center, San Diego, CA (USA)). Apr 1988. 26p. (NOSC/TR—1205). NTIS, PC A03/MF A01.

A threat assessment expert system is written provides textual explanation of its conclusion, allows the user to modify--at run-time--the threat assessment tasks performed, and captures these user modifications for knowledge acquisition. The run-time method used to define the constituent elements of a threat situation is outlined in depth. The computer program compares the components of a threat event (defined by a knowledgeable user) with the dynamic track data base. If the threat event occurs, a warning is issued to the user. This definition of a threat event is added to the program and thus acts as run-time knowledge acquisition. The matching between the user defined attributes and the corresponding track data is displayed for explanation.

42476 **(AD-A—191718/6/XAB) Decomposition of linear programs using parallel computation. Technical report.** Ho, J.K.; Lee, T.C.; Sundarraj, R.P. (Tennessee Univ., Knoxville (USA). Management Science Program). Jul 1987. 23p. (MSP—87-4). NTIS, PC A03/MF A01.

This paper describes DECOMPAR: an implementation of the Dantzig-Wolfe decomposition algorithm for block-angular linear programs using parallel processing of the subproblems. The software is based on a robust experimental code for LP decomposition and runs on the CRYSTAL multi-computer at the University of Wisconsin-Madison. Initial computational experience is reported. Promising directions in future development of this approach are discussed.

42477 **(AD-A—191756/6/XAB) Signal-processing computational needs. Professional paper for period ending August 1986.** Speiser, J.M. (Naval Ocean Systems Center, San Diego, CA (USA)). Nov 1987. 6p. NTIS, PC A02/MF A01.

Availability: Document Partially Illegible.

Previous reviews of signal-processing computational needs and their systolic implementation have emphasized the need for a small set of matrix operations, primarily matrix multiplication, orthogonal triangularization, triangular backsolve, singular-value decomposition, and the generalized singular-value decomposition. Algorithms and architectures for these tasks are sufficiently well understood to begin transitioning from search to exploratory development. Substantial progress has also been reported on parallel algorithms for updating symmetric eigensystems and the singular-value decomposition. Another problem that has proved to be easier than expected is inner-product computation for high-speed high resolution predictive analog-to-digital conversion. Although inner product computation in a general setting will require O(log n) time via a tree, the special structure of the prediction permits the use of a systolic transversal filter, producing a new predicted value in time O(1). Problem areas which are still in an early of study include parallel algorithms for the Wigner-Ville Distribution function, L1 norm approximation, inequality constrained least squares, and the total least squares problem.

42478 **(AD-A—191866/3/XAB) Beyond Ada - generating Ada code from equational specifications.** Szymanski, B.K. (Rensselaer Polytechnic Inst., Troy, NY (USA). Dept. of Computer Science). 1987. 6p. NTIS, PC A02/MF A01.

Real-time mission-oriented embedded systems are much more difficult to design than ordinary software systems. They require highly reliable and efficient implementations to satisfy mission and time constraints imposed by the applications. The Ada language was designed to facilitate real-time-system software development. However, for many programmers the size and complexity of Ada itself are of concern. In the assertive programming paradigm, computations are specified as sets of assertions about properties of the solution, and not as a sequence of procedural steps. Solving procedures are automatically generated from the assertive description. Real-time programming for mission-oriented systems is supported by equational languages in which assertions are expressed as algebraic equations. Programs written in equational languages are concise, free from implementation details, and easily amenable to verification and parallel processing. The level of programming expertise required to program in an equational language is much lower than the level that is needed by Ada programmers. This paper describes an implementation of an equational-language system that generates highly efficient distributed code in Ada. It also demonstrates how the equational-language system can be used in real-time software development.

42479 **(AD-A—191906/7/XAB) ROBART II: an intelligent security robot. Professional paper for June 1987.** Everett, H.R.; Bianchini, G.L. (Naval Ocean Systems Center, San Diego, CA (USA)). Dec 1987. 12p. NTIS, PC A03/MF A01.

ROBART II is a battery-powered autonomous sentry robot used by the Naval Ocean Systems Center in San Diego as a testbed in the research areas of environmental modeling and intelligent security assessment. An architecture of nine distributed microprocessors makes possible advanced control strategies and real-time data acquisition capability. Higher level functionality (map generation, path planning, position estimation, obstacle avoidance and statistical security assessment) is currently implemented by the Planner on an IBM-PC/AT computer, using a radio link for communication with the Scheduler. Numerous sensors are incorporated into the system to yield appropriate information for use in collision avoidance, navigational planning, environmental awareness, assessing terrain traversability, and performing security-related functions. Two separate drive motors provide for differential steering, allowing the robot to turn in place in order to maneuver in congested indoor environments. The entire unit is housed in a rugged plastic and fiberglass body, measuring 17 inches wide and 23 inches long at the base, and extending to a height of 50 inches. Special internal-circuitry checkpoints are analyzed by self-diagnostic software, and operator assistance is requested if necessary through speech synthesis.

42480 **(AD-A—192086/7/XAB) Intermediate-level computer-vision-processing algorithm development for the content-addressable-array parallel processor. Quarterly status report No. 6, 1 September-30 November 1987.** Riseman, E. (Massachusetts Univ., Amherst (USA)). 29 Nov 1987. 40p. NTIS, PC A03/MF A01.

From September through November the author concentrated on the development of an Integrated Image Understanding Benchmark for computer-vision architectures. Unlike previous vision benchmarks, this new benchmark is designed to test machine performance on a complete interpretation task. The task chosen will require not only that common low-level vision operations be performed, but that intermediate-level operations and interactions between operations be tested as well. In fact, the emphasis of the benchmark is on intermediate - or high-level processes controlling lower-level processing in a top-down manner. The goal of the interpretation task is to recognize a modeled object in a cluttered environment. The input to the system is a set of models, any one of which may be present in the scene, and a pair of registered images. One of the images is from a black and white 8-bit intensity sensor, and the other is from a 32-bit floating-point range sensor. For the purposes of the benchmark, the images are artificially created.

42481 **(ANL/MCS-TM—116) Convergence properties of trust region methods for linear and convex constraints.** Burke, J.V.; More, J.J.; Toraldo, G. (Argonne National Lab., IL (USA)). Apr 1988. Contract W-31109-ENG-38. 32p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88013608/JAW.

We develop a convergence theory for convex and linearly constrained trust region methods which only requires that the step between iterates produce a sufficient reduction in the trust region subproblem. Global convergence is established for a general convex minimization problem while the local analysis is for linearly constrained problems. The main local result establishes that if the sequence converges to a nondegenerate stationary point then the active constraints at the solution are identified in a finite number of iterations. As a consequence of the identification properties, we develop rate of convergence results by assuming that the step is a truncated Newton method. Our development is mainly geometrical; this approach allows the development of a convergence theory without any linear independence assumptions. 20 refs., 1 fig.

42482 **(ANL/MCS-TM—120) Tools to aid in the analysis of memory access patterns for Fortran programs: LAPACK working note No. 6.** Brewer, O.; Dongarra, J.; Sorensen, D. (Argonne National Lab., IL (USA)). Jun 1988. Contract W-31109-ENG-38. 16p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88013609/JAW.

The goals of this work is to assist in formulating correct algorithms for high-performance computers and to aid as much as possible the process of translating an algorithm into an efficient implementation on a specific machine. Over the past five years we have developed approaches in the design of certain numerical algorithms that allow both efficient and portability. Our current efforts emphasize three areas: environments for algorithm development, parallel programming methodologies, and advanced algorithm development. 9 refs., 3 figs.

42483 **(BDX—613-3945) LOOPBAK Verification Testing Program for NOS to NOS/VE data migration.** Moore, W. M. (Allied-Signal Aerospace Co., Kansas City, MO (USA). Kansas City Div.). May 1988. Contract AC04-76DP00613. 38p. NTIS, PC A03/MF A01; GPO Dep. Order Number DE88011638/JAW.

LOOPBAK is a part definition verification utility for the migration of ICEMDDN drawing files from a NOS operating system to a NOS/VE operating system. This software only verifies the accuracy of the drawing file; it does not perform the actual migration. It is used with the migration utilities provided by Control Data Corporation (Programs Part A and Part B). The software verifies the accuracy of part definitions in IPARTA format on the VE side after the data have been migrated. The software then returns the migrated data to the NOS side, converts the data to IPARTD format, and compares the data to its original definition. The software works with ICEMDDN version 1.6.4 and higher on the NOS side and ICEMDDN version 2.0 on the VE side. The NOS version used is 2.4.1 and the VE version is 1.2.3. The software is initiated on the NOS operating system and links to the VE operating system, via batch jobs, internal to the program. 1 fig.

42484 **(BNL—51911-Rev.) Guide to computing facilities at Brookhaven National Laboratory.** Fuchel, K. (ed.). (Brookhaven National Lab., Upton, NY (USA)). Mar 1988. Contract AC02-76CH00016. 56p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE88012935/JAW.

This paper describes the computing capabilities of Brookhaven National Laboratory. Particular topics discussed are: Central Scientific Computing Center (CSCF) facilities; computer networks; getting started using the CSCF; file storage and exchange; personal computers and engineering workstations; computer graphics; and database systems.

42485 **(CEA-CONF—9197) Fractals and multifractals in physics.** Arcangelis, L. de. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Service de Physique Theorique). 1987. 20p. (CONF-8706314—). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88753901/JAW.

From Summer school disorder and mixing; Cargese, France (14 Jun 1987).

We present a general introduction to the world of fractals. The attention is mainly devoted to stress how fractals do indeed appear in the real world and to find quantitative methods for characterizing their properties. The idea of multifractality is also introduced and it is presented in more details within the framework of the percolation problem.

42486 **(DOE/ER/25026—21) Unified multilevel adaptive finite element methods for elliptic problems.** Mitchell, W.F. (Illinois Univ., Urbana (USA). Dept. of Computer Science). May 1988. Contract FG02-87ER25026. 111p. (UIUCDCS-R—88-1436; UILU-ENG—88-1741). NTIS, PC A06/MF A01;1; GPO Dep. Order Number DE88011938/JAW.

Many elliptic partial differential equations can be solved numerically with near optimal efficiency through the uses of adaptive refinement and multigrid solution techniques. It is our goal to develop a more unified approach to the combined process of adaptive refinement and multigrid solution which can be with high order finite elements. The basic step of the refinement process is the bisection of a pair of triangles, which corresponds to the addition of one or more basis functions to the approximation space. An approximation of the resulting change in the solution is used as an error indicator to determine which triangles to divide. The multigrid iteration uses a red-black Gauss--Seidel relaxation in which the black relaxations are used only locally. The grid transfers use the change between the nodal and hierarchical bases. This multigrid iteration requires only O({Nu}) operations, even for highly nonuniform grids, and is defined for any finite element space. The full multigrid method is an optimal blending of the processes of adaptive refinement and multigrid iteration. So as to minimize the number of operations required, the duration of the refinement phase is based on increasing the dimension of the approximation space by some fixed factor which is determined to be the largest possible for the given error-reducing power of the multigrid iteration. The result is an algorithm which (i) uses only O({Nu}) operations with a reasonable constant of proportionality, (ii) solves the discrete system to the accuracy of the discretization error, (iii) is able to achieve the optimal order of convergence of the discretization error in the presence of singularities. Numerical experiments confirm this for linear, quadratic and cubic elements. It is believed that the method can also be applied to more practical problems involving systems of PDE'S, time dependence, and three spatial dimensions. 39 refs.

42487 **(EUR—10946) MAPLE-II. A program for plotting fault trees: description and how to use.** Poucet, A.; Van Den Muyzenberg, C.L. (Commission of the European Communities, Luxembourg). 1987. 34p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88752454/JAW.

The MAPLE II code is an improved version of the MAPLE program for plotting fault trees. MAPLE II has added features which make it a versatile tool for drawing large and complex logic trees. The code is developed as part of a package for computer aided fault tree construction and analysis in which it is integrated and used as a documentation tool. However the MAPLE II code can be used as a separate program which uses as input a structure function of a tree and a description of the events and gates which make up the tree. This report includes a short description of the code and of its features. Moreover it contains the how-to-use and some indications for implementing the code and for adapting it to different graphics systems.

42488 **(EUR—10966) Consys Linear Control System Design Software Package.** Diamantidis, Z. (Commission of the European Communities, Luxembourg). 1987. 83p. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88752394/JAW.

This package is created in order to help engineers, researchers, students and all who work on linear control systems. The software includes all time and frequency domain analysises, spectral analysises and networks, active filters and regulators design aids. The programmes are written on Hewlett Packard computer in Basic 4.0.

42489 **(EUR—11032) Problems of variance reduction in the simulation of random variables.** Lessi, O. (Commission of the European Communities, Luxembourg). 1987. 43p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88752396/JAW.

The definition of the uniform linear generator is given and some of the mostly used tests to evaluate the uniformity and the independence of the obtained determinations are listed. The problem of calculating, through simulation, some moment W of a random variable function is taken into account. The Monte Carlo method enables the moment W to be estimated and the estimator variance to be obtained. Some techniques for the construction of other estimators of W with a reduced variance are introduced.

42490 **(EUR—11035) Variance reduction techniques in the simulation of Markov processes.** Lessi, O. (Commission of the European Communities, Luxembourg). 1987. 22p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88752395/JAW.

We study a functional r of the stationary distribution of a homogeneous Markov chain. It is often difficult or impossible to perform the analytical calculation of r and so it is reasonable to estimate r by a simulation process. A consistent estimator r(n) of r is obtained with respect to a chain with a countable state space. Suitably modifying the estimator r(n) of r one obtains a new consistent estimator which has a smaller variance than r(n). The same is obtained in the case of finite state space.

42491 **(GA-A—19031) The steady states of the Kuramoto--Sivashinsky equation.** Greene, J.M.; Kim, J.S. (General Atomics Co., San Diego, CA (USA)). Dec 1987. Contract FG03-85ER13402. 49p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88011819/JAW.

The Kuramoto--Sivashinsky equation is one of the simple nonlinear partial diffential equations. It represents a system in which the transport of energy through nonlinear mode coupling

produces a balance between long wavelength instability and short wavelength dissipation. The steady states and their stabilities give a foundation for understanding the dynamics of the system. They are distinguished according to their energy levels and fall into different branches that are identified by their harmonic content. Various types of solution include laminar states, N-cell states, long wave distorted N-cell states, the giant states, and steady traveling solutions. The linear stability around the steady states gives a guide to the origin of additional steady states through bifurcation and to the identification of each steady state. The index rule is also useful. Conjectured from the numerical observation, the parameter dependence of the steady traveling waves is estimated in the limit of large values of the parameter. In addition, a singular perturbation calculation of traveling waves near bifurcation is carried out. The dynamics of a system can be guided by the systematic study of the bifurcation and stability. For example, if all the stationary and periodic solutions are unstable for some parameter range, chaotic behavior of the system is expected, since any orbit governed by the equation has to wander around forever in the phase space. The orbits will then lie on strange attractors. 18 refs., 9 figs.

42492 **(GAO/NSIAD—87-154BR) Contracting: Air force procurement of prototype fuels dispensing system.** (General Accounting Office, Washington, DC (USA)). 1987. 10p. General Accounting Office, PO Box 6015, Gaithersburg, MD 20877.

In September 1985 the Air Force awarded Gull, Incorporated, a firm, fixed-price contract to design, fabricate, furnish, test, and install an automated data collection and fuels dispensing prototype system to determine the feasibility and cost effectiveness of automation for improved petroleum fuels accountability. In October 1985 Liquid Controls Corporation protested the award contending that Gull's product would not meet the contract specifications. The Air Force concluded that the allegations were speculative and did not show a deficiency in the Air Force determination of responsible bidder. GAO dismissed the protest. Contract modification provides for installation of the prototype system by June 1987.

42493 **(JAERI-M—88-030) Interactive graphics processor - ROPS 2.0 - user's manual.** Anoda, Yoshinari; Hosoyamada, Ryuji; Shimane, Yukio; Hamada, Kuniyasu. (Japan Atomic Energy Research Inst., Tokyo). Feb 1988. 192p. (In Japanese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88754116/JAW.

ROPS 2.0 is an interactive graphics program designed to perform computer graphics, mathematical manipulations and reformatting of data. The objectives in writing ROPS 2.0 were that it be fast, easy to use and versatile. The program accepts input data from a number of commonly used data formats at the Department of Reactor Safety Research of Japan Atomic Energy Research Institute (JAERI). Also user can input data directly from the terminal. The computer graphics software utilized in the code is DISSPLA (Display Integrated Software System and Plotting Language). TEKTRONIX MODEL 4014 CRT keyboard terminals is supported. Also supported is the capability to route plots to the NLP (Nihongo Line Printer).

42494 **(JINR—R-10-87-206) Minimum operating system based on the SM5300.01 magnetic tape recorder for the Micro-8 computer.** Kartashov, S.V. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1987. 9p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88701670/JAW.

An operating system (OS) for microcomputers based on INTEL-8080, 8085 microprocessors oriented to use a magnetic tape recorder is described. This system comprises a tape-recorder manager and a file structure organization system (nucleus of OS), a symbol text editor, a macroassembler, an interactive disasembler and a program of communication with an EC-computer. The OS makes it possible to develop, debug, store and exploit the program written in INTEL-8085 assembly language. 9 refs.

42495 **(JINR—R-11-87-332) SLIPH4 program for numerical solution of the Sturm - Liouville problem.** Puzynin, I.V.; Puzynina, T.P.; Strizh, T.A. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Computing Techniques and Automation). 1987. 18p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88701676/JAW.

The SLIPH4 program complex for the numerical solution of the Sturm-Liouville problem for the second-order homogeneous linear differential equation with homogeneous boundary conditions is described. The continuous analogue of the Newton method is used. The descrete scheme that has been realized in the approach provides an accuracy of the order of four with respect to the mesh step of the independent variable. The program for the initial approximation to the solution calculations with the help of a modified Newton method for the polynomial roots finding with the calculated root elimination is added to the complex. The possibility of using the modified method with eigenvalue fixing and obtained approximate eigenfunction additional orthogonalization is realied. This permits to solve both the initial approximation problem and its more precise definition by the same scheme. The program description is presented. Examples illustrating the program complex using are given. 12 refs.; 1 fig.; 3 tabs.

42496 **(KFTI—87-14) Method of paralleling computer calculation for two-dimensional kinetic plasma model.** Brazhnik, V.A.; Demchenko, V.V.; Dem'yanov, V.G.; D'yakov, V.E.; Ol'shanskij, V.V.; Panchenko, V.I. (AN Ukrainskoj SSR, Kharkov. Fiziko-Tekhnicheskij Inst.). 1987. 14p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88701680/JAW.

A method for parallel computer calculation and OSIRIS program complex realizing it and designed for numerical plasma simulation by the macroparticle method are described. The calculation can be carried out either with one or simultaneously with two computers BESM-6, that is provided by some package of interacting programs functioning in every computer. Program interaction in every computer is based on event techniques realized in OS DISPAK. Parallel computer calculation with two BESM-6 computers allows to accelerate the computation 1.5 times. 6 refs.; 1 fig.

42497 **(KIYI—86-30) Organization and procedures of working out of program servicing systems of nuclear-physical experiments in FB-monitor of RAFOS system.** Zerkin, V.V. (AN Ukrainskoj SSR, Kiev. Inst. Yadernykh Issledovanij). 1986. 21p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88701685/JAW.

Organization of program systems of data acquisition and its primary processing during experiments based on the distribution of these processes into sections of FB-monitors of RAFOS system is presented. The procedures of working out of such programmes are considered. A great protection of processes, the programme simplification and optimization of the use of computer equipment is achieved. 9 refs.; 4 figs.

42498 **(KU-HCOE-FL2-R—87-9) On lumped models for thermodynamic properties of simulated annealing problems.** Andresen, B.; Pedersen, J.M.; Salamon, P.; Hoffmann, K.H.; Mosegaard, K.; Nulton, J. (Copenhagen Univ. (Denmark). H.C. Oersted Inst.; Heidelberg Univ. (Germany, F.R.). Inst. fuer Theoretische Physik). 1987. 27p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88752691/JAW.

The paper describes a new method for the estimation of thermodynamic properties for simulated annealing problems using data obtained during a simulated annealing run. The method works by estimating energy-to-energy transition probabilities and is well adapted to simulations such as simulated annealing, in which the system is never in equilibrium.

42499 **(LA—10857) Elastic-plastic flow using operator splitting and particle-in-cell methods in a two-dimensional Eulerian hydrodynamic code.** Lee, Wen Ho; Kwak, Dochan. (Los Alamos National Lab., NM (USA)). Mar 1988. Contract W-7405-ENG-36. 60p. NTIS, PC A04/MF A01;1; GPO Dep. Order Number DE88010469/JAW.

The particle-in-cell method has been used for computing compressible, multimaterial problems for more than 20 years. Current work extends the same numerical approximation with operator splitting to hydro-elastic-plastic flow problems in two-dimensional Eulerian coordinates. In the operator splitting method, the basic set of cylindrical equations is split in radial (r) and axial (z) directions. The calculations, performed in each direction separately, are alternated for each time advancement to maintain the accuracy of one-dimensional procedure. A shaped charge problem is treated with the present code, and the results are compared with the experimental data and with results from other codes. 12 refs., 22 figs.

42500 **(LA—11216-MS) C-Division annual review and operating plan.** Morse, N.R. (Los Alamos National Lab., NM (USA)). Jan 1988. Contract W-7405-ENG-36. 149p. NTIS, PC A07/MF A01; GPO Dep. Order Number DE88010507/JAW.

The Computing and Communications Division is responsible for the Laboratory's Integrated Computing Network as well as Laboratory-wide telecommunications. Our computing network is used by more than 8000 people distributed throughout the nation and constitutes one of the most powerful scientific computing facilities in the world. This document, published annually, is written for our clients and their management, key personnel in government, and personnel in our own division. Divided into three parts, its purpose is to review our accomplishments and facilities during FY 1987, describe the goals and projects of our strategic plan, and describe our operating plans in FY 1988 and FY 1989 for several areas of our operation. We also describe our mission and objectives, planning considerations, and management policies and practices.

42501 **(LA—11321-MS) Beginner's guide to SPICE.** Geisik, C.; Schilling, L. (ed.). (Los Alamos National Lab., NM (USA)). Jul 1988. Contract AC08-88NV10617. 43p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88012562/JAW.

This work is intended to help a beginner learn the fundamentals of the circuit simulation program SPICE using a series of increasingly complex examples. These examples take the beginner from the most elementary circuits on up to an operational amplifier model. This work serves as a supplement to the existing SPICE documentation SPICE User's Guide. 13 figs.

42502 **(LBL—24643) Programming abstractions for run-time partitioning of scientific continuum calculations running on multiprocessors.** Baden, S.B. (Lawrence Berkeley Lab., CA (USA)). Jan 1988. Contract AC03-76SF00098. 12p. (CONF-871251—5). NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88007376/JAW.

From 3. SIAM conference on parallel processing for scientific computing; Los Angeles, CA, USA (1 Dec 1987).

The author discusses a set of software abstractions for implementing various math-physics calculations on a team of processors. He tried out the abstractions on Anderson's Method of Local Corrections, a type of vortex method for computational fluid dynamics. He ran experiments on 32 processors of the Intel iPSC - a message-passing hypercube architecture - and on 4 processors of a Cray X-MP - a shared-memory vector architecture - and achieved good parallel speedups of 24 and 3.6 respectively. The abstractions should apply to diverse applications, including finite difference methods, and to diverse architectures without requiring that the application be reprogrammed extensively for each new architecture. 14 refs., 4 figs., 3 tabs.

42503 **(ORNL/CSD/TM—260) VAX/VMS file protection on the STC [Scientific and Technical Computing] VAXES.** (Oak Ridge National Lab., TN (USA)). Jun 1988. Contract AC05-84OR21400. 23p. NTIS, PC A03/MF A01; GPO Dep. Order Number DE88012716/JAW.

This manual is a guide to use the file protection mechanisms available on the Martin Marietta Energy Systems, Inc. Scientific and Technical Computing (STC) System VAXes. User identification codes (UICs) and general identifiers are discussed as a basis for understanding UIC-based and access control list (ACL) protection. 5 figs.

42504 **(ORNL/TM—10748) Consensus for belief functions and related uncertainty measures.** Wagner, C.G. (Oak Ridge National Lab., TN (USA)). Apr 1988. Contract AC05-84OR21400. 12p. NTIS, PC A03/MF A01; GPO Dep. Order Number DE88007917/JAW.

We extend previous work of Lehrer and Wagner, and of McConway, on the consensus of probabilities, showing under axioms similar to theirs that (1) a belief function consensus of belief functions on a set with at least three members and (2) a belief function consensus of Bayesian belief functions on a set with at least four members must take the form of a weighted arithmetic mean. 5 refs.

42505 **(ORNL/TM—10764) Adaptive optimal control of uncertain nonlinear systems: On-line microprocessor-based algorithm to control mechanical manipulators.** March-Leuba, Carlos; Perez, R. B. (Oak Ridge National Lab., TN (USA)). May 1988. Contract AC05-84OR21400. 32p. (CESAR—88/19). NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88011373/JAW.

This paper presents an adaptive optimal control algorithm for uncertain nonlinear systems. A variational technique based on Pontryagin's Maximum Principle is used to track the system's unknown terms and to calculate the optimal control. The reformulation of the variational technique as an Initial Value Problem allows this microprocessor-based algorithm to perform on-line model-updating and control. To validate the algorithm a system representing a two-link mechanical manipulator is simulated. In the control model, the coupling and friction terms are unknown. The robot's task is to follow a prescribed trajectory and to pick up an unknown mass. 5 refs., 3 figs., 1 tab.

42506 **(ORNL/TM—10772) Solution of ill-posed problems by means of Truncated SVD [Singular Value Decomposition].** Hansen, P.C. (USDOE, Washington, DC; Oak Ridge National Lab., TN (USA)). Jun 1988. Contract AC05-84OR21400. 18p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88013510/JAW.

We investigate {ital Truncated Singular Value Decomposition} (TSVD) solutions to ill-posed least squares problems involving matrices with ill-determined as well as well-determined numerical rank. If a {ital discrete Picard condition} is satisfied, then in {ital both cases} the truncation parameter can be chosen such that the TSVD solution is satisfactory. The appropriate truncation parameter, giving the optimal signal-to-noise ratio in the solution, is the minimizer of the generalized cross-validation. 26 refs.

42507 **(PB—88-182514/XAB) Transaction mechanisms in parallel data-base machines.** Kvittem, O.; Nygard, M.; Risnes, O. (SINTEF, Trondheim (Norway)). 31 Dec 1986. 28p. (STF—14-A86064). NTIS, PC E04/MF E04.

The development of parallel technology has made it possible to construct cost-efficient high-performance parallel data-base machines. On the basis of the properties of the developments in hardware technology, recent developments in techniques for data-base operations, and current algorithms for concurrency control, the authors have investigated the combined effects on DBMS design. First, they show that a particular machine architecture gives a steadily increasing performance potential for increasing number of processors for large equi-join operations using a hashing algorithm. Secondly, the authors pose the hypothesis that the choice of algorithms used for concurrency control - in this tightly coupled distributed data-base environment - will change from traditional distributed algorithms towards something more like those of a uniprocessor. The reason for this is the increasing speed of inter-processor communication relative to main memory access times. They conclude by recommending a way to investigate this hypothesis.

42508 **(PB—88-184155/XAB) Parallelization of Gauss-Seidel algorithms as an example of parallel iterative equation solving.** Dekker, L. (Technische Hogeschool Delft (Netherlands). Onderafdeling der Wiskunde en Informatica). 1987. 58p. (REPT—87-76). NTIS, PC E04/MF A01.

In chapter 1, the parallelization of the point Gauss-Seidel (G.S.) algorithm is studied for nonlinear equations in the case that the equation solving is done by sequential subtask processing. Dataflow analysis shows that m equations can be processed by p=m processors in parallel by means of so-called skewed parallel batch processing with an asymptotic causal speed-up s(sub c, infinity)=p and ditto causal efficiency e(sub c, infinity)=1. In chapter 2, the parallelization of the point G.S. algorithm is studied for linear equations. First, in the case of sequential equation solving, the authors discuss how to apply skewed parallel processing for full matrices as well as for band matrices. Section 2.4 discusses some parallel point G.S. algorithms obtained by parallelization of the function evaluations by means of parallel-sequential algorithms. G.S. algorithms can not be more than m as a consequence of the fact that point iterative methods have a low degree of explicity. In chapter 3, the parallelization of the multi-point and block G.S. algorithms is studied (for linear equations) in order to demonstrate that an increase of explicity results in more speed-up.

42509 **(PB—88-864152/XAB) Parallel processing. July 1985-May 1988 (Citations from the NTIS data base). Report for July 1985-May 1988.** (National Technical Information Service, Springfield, VA (USA)). May 1988. 121p. NTIS PC N01/MF N01.

Supersedes PB—87-860904.

This bibliography contains citations concerning theoretical analyses and applications of parallel-processing systems and operations. Topics include image and signal processing, programming languages, algorithm and architecture descriptions, and utilization in optimization problems. Descriptions of specific machines used in problem-solving systems are presented. (This updated bibliography contains 248 citations, 83 of which are new entries to the previous edition.)

42510 **(PB—88-864178/XAB) Supercomputers: market aspects. January 1983-May 1988 (Citations from the Computer data base). Report for January 1983-May 1988.** (National Technical Information Service, Springfield, VA (USA)). May 1988. 160p. NTIS PC N01/MF N01.

Supersedes PB—87-861514.

This bibliography contains citations concerning market trends, and demand forecasting for supercomputers, and related services and products. Overseas markets and competition, including Japanese development efforts, software availability, and the utilization of supercomputers by specific companies are among the topics presented. Efforts to develop equipment to fill market gaps are also discussed. Considerable attention is given to superminis and low-end supercomputers. Citations pertaining specifically to supermicros are excluded. (This updated bibliography contains 369 citations, 64 of which are new entries to the previous edition.)

42511 **(PB—88-864525/XAB) Single or multiple instruction-multiple data stream architecture (SIMD & MIMD). January 1983-May 1988 (Citations from the Computer data base). Report for January 1983-May 1988.** (National Technical Information Service, Springfield, VA (USA)). May 1988. 43p. NTIS PC N01/MF N01.

Supersedes PB—87-860367.

This bibliography contains citations concerning the development, evaluation, and applications of single or multiple instruction-multiple data stream computers and architecture. Topics include multiprocessing systems, supercomputers, array computers, parallel architecture and algorithms, VLSI technology, and massively paralleled processors. Application include image and graphics processing, mathematical computations, and communication-switching systems. (This updated bibliography contains 80 citations, 16 of which are new entries to the previous edition.)

42512 **(PNL—6434) Statistical evaluation of PACSTAT random number generation capabilities.** Piepel, G.F.; Toland, M.R.; Harty, H.; Budden, M.J.; Bartley, C.L. (Pacific Northwest Lab., Richland, WA (USA)). May 1988. Contract AC06-76RL01830. 308p. NTIS, PC A14/MF A01; 1; GPO Dep. Order Number DE88012754/JAW.

This report summarizes the work performed in verifying the general purpose Monte Carlo driver-program PACSTAT. The main objective of the work was to verify the performance of PACSTAT's random number generation capabilities. Secondary objectives were to document (using controlled configuration management procedures) changes made in PACSTAT at Pacific Northwest Laboratory, and to assure that PACSTAT input and output files satisfy quality assurance traceability constraints. Upon receipt of the PRIME version of the PACSTAT code from the Basalt Waste Isolation Project, Pacific Northwest Laboratory staff converted the code to run on Digital Equipment Corporation (DEC) VAXs. The modifications to PACSTAT were implemented using the WITNESS configuration management system, with the modifications themselves intended to make the code as portable as possible. Certain modifications were made to make the PACSTAT input and output files conform to quality assurance traceability constraints. 10 refs., 17 figs., 6 tabs.

42513 **(SAND—87-2563C) Knowledge system approach to automated two-dimensional quadrilateral mesh generation.** Blacker, T.D.; Mitchiner, J.L.; Phillips, L.R.; Lin, Y.T. (Sandia National Labs., Albuquerque, NM (USA)). 1988. Contract AC04-76DP00789. 30p. (CONF-880719—2). NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88004461/JAW.

From ASME international computers in engineering conference and exhibition; San Francisco, CA, USA (31 Jul 1988).

We have developed a knowledge system approach that automates 2-D quadrilateral mesh generation. This approach employs an extensive knowledge system, AMEKS (Automated MEshing Knowledge System), the basic transfinite mapping algorithm for generation of quadrilateral elements, and a set of higher-order primitive decomposition algorithms. The entire system mimics experienced analysts' approaches to meshing 2-D geometries and automatically meshes a large class of 2-D geometries with well-formed quadrilateral elements. Because analysts use transfinite mapping algorithms to generate 3-D hexahedral meshes, we plan to extend our system to mimic analysts' approaches to 3-D hexahedral mesh generation.

42514 **(SAND—88-0018) Software overview for the Interim Annunciator Communication System.** Doerfler, D.W. (Sandia National Labs., Albuquerque, NM (USA)). Mar 1988. Contract AC04-76DP00789. 116p. NTIS, PC A06/MF A01;1; GPO Dep. Order Number DE88008590/JAW.

This document provides an overview of the software generated for the Interim Annunciator Communication System (IACS), an interior/exterior alarm communication system. This document was written with the assumption that the reader is familiar with the purpose of the IACS, its architecture, its hardware, and its intended environment. A discussion of the following will be provided: the IACS software requirements, an overview of the software architecture, the development environment, the software generation procedures, the generation of target environment images, and a description of each module written to implement the IACS. 6 refs.

42515 **(SAND—88-0905) STAR: Sandia Timing Analyzer Routine.** Donham, B.L. (Sandia National Labs., Albuquerque, NM (USA)). Mar 1988. Contract AC04-76DP00789. 25p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88012412/JAW.

Existing tools for circuit simulation have proven to be inadequate to accommodate the continuing increase in complexity and size of integrated circuits. Such a deficiency in simulation capability exists due to the limitations of both logic simulators and circuit simulators. Logic simulators, which functionally verify circuit operation, are unable to verify timing with the accuracy required to produce reliable parts. Circuit simulators, which, in the past, have been used to provide accurate timing verification, cannot simulate

entire circuits due to design size and speed bounds. This report introduces STAR, a CAD tool which addresses the simulation problem for complex integrated circuits, and enables a system to be simulated on a logic simulator with the accuracy of a circuit simulator. 13 figs.

42516 **(SAND—88-1281) A performance model for massive parallelism.** Gustafson, J.L. (Sandia National Labs., Albuquerque, NM (USA)). May 1988. Contract AC04-76DP00789. 23p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88011763/JAW.

A popular argument is that vector and parallel architectures should not be carried to extremes because the scalar or serial portion of the code will eventually dominate. Since pipeline stages and extra processors obviously add hardware cost, a corollary to this argument is that the most cost-effective computer is one based on uniprocessor, scalar principles. For architectures that are both parallel and vector, the argument is compounded, making it appear that near-optimal performance on such architectures is a near-impossibility. A new argument is presented that is based on the assumption that program execution time, not problem size, is constant for various amounts of vectorization and parallelism. This has a dramatic effect on Amdahl Law, revealing that one can be much more optimistic about achieving high speedups on massively-parallel and highly-vectorized machines. The revised argument is supported by recent results of over 1000 times speedup on 1024 processors on several practical scientific applications. This document discusses the results and presents a reevaluation of Amdahl's Law.

42517 **(TR—88-14) BLITZ: Blitzen's micron-code assembly language design document, version 1.0.** Rosenberg, J.B.; Davis, E.W. (Duke Univ., Durham, NC (USA)). Mar 1988. 29p. Issuing Activity.

The SIMD massively parallel machines typically require large volumes of micro-code to implement a normal instruction set as seen by a high-level language compiler. Most microcode languages for this class of machine are very terse and are therefore extremely error-prone and difficult to write. The BLITZ is a high-level C-like microcode language for the SIMD massively parallel architecture known as BLITZEN. This document is a design document that describes in detail the syntax and semantics of the BLITZ microcode language.

42518 **(UCID—21382) Praxis I/O package.** Holloway, F.W.; Sherman, T.A. (Lawrence Livermore National Lab., CA (USA)). 7 Apr 1988. Contract W-7405-ENG-48. 174p. NTIS, PC A08/MF A01; GPO Dep. Order Number DE88009539/JAW.

The Praxis language specification, like Algol and Ada, does not specify any I/O statements. The intent was to provide a standard I/O package as a companion to the compiler. This would allow the user to substitute, or supplement, the I/O package, as needed, for specialized applications. Like Algol, however, Praxis provided only limited (text) I/O for several years. Ada, in contrast, provided a comprehensive standard I/O package from its inception. Digital Equipment Corporation's (DEC's) implementation of Ada, on their VAX family of computers, further supplemented this package with other packages which exploit the I/O facilities available under the VMS operating system. The Praxis I/O package described in this document has been modeled after DEC's implementation of Ada and provides a similar set of I/O facilities. Currently, the I/O package is supported only under VAX/VMS. The design of the package, however, is essentially independent of any operating system (with the exception of the module COMMAND IO). The VAX/VMS version of the I/O package fully exploits the vast I/O facilities which are provided under VAX/VMS and makes them directly available to the Praxis programmer. The design, prototype implementation, and draft documentation of the Praxis I/O Package was done by Tim Sherman as part of a University project in computer science. Subsequent work by both Tim and Fred Holloway lead to a more complete implementation, testing and development of example programs, and inclusion of the package into the Praxis compilers as their principal interface to RMS and VMS.

42519 **(UCID—21437) Guidelines for using TIPSFD for 3D finite-difference mesh generation.** Laguna, G.W. (Lawrence Livermore National Lab., CA (USA)). May 1988. Contract W-7405-ENG-48. 41p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88012451/JAW.

This report presents information to give users of the TIPSFD code a better understanding of how it can be used to generate finite-difference meshes. In particular, this report presents in detail all of the mesh generation parameters and the rationale behind them, in addition to guidelines for creating the initial solid model. This report also presents recently developed features for generating meshes as well as a complete example from solid model creation to mesh generation. 5 refs., 25 figs., 1 tab.

42520 **(UCRL—15934) Comparison of CCITT Group 4 compression with wrap-around and standard CCITT Group 4 compression.** (Lawrence Livermore National Lab., CA (USA); Alpharel, Inc., Camarillo, CA (USA); West Coast Information System, Walnut Creek, CA (USA)). 29 Feb 1988. Contract W-7405-ENG-48. 63p.. (AITI—87-001). NTIS, PC A04. Order Number DE88012235/JAW.

This report documents the results of a test conducted to investigate and compare the difference in performance between two different compression algorithms. For the test, aperture cards containing a series of A through E size engineering drawings were captured first utilizing CCITT Group 4 compression with "wrap around" and subsequently utilizing "standard" CCITT Group 4 compression. Samples consisting of 20 Army aperture cards and 20 Air Force aperture cards were used for the test. Each aperture card sample contained four A,B,C,D, and E size drawings. The forty(40) aperture cards were scanned, and the images were first compressed with the "wrap around" algorithm used in the DSREDS/EDCARS systems. The compressed image file sizes were recorded, and the compression ratios were calculated. The image files were subsequently decompressed and input into a PC-resident KoFax board that compressed the image files utilizing the standard CCITT Group 4 compression algorithm modified for larger drawings. Compressed image file sizes were recorded, and the compression ratios were calculated. Results of the test are summarized and presented in this report.

42521 **(UCRL—98395) Number crunching with a PC.** Foch, J. (Lawrence Livermore National Lab., CA (USA)). 8 Mar 1988. Contract W-7405-ENG-48. 5p. (CONF-880389—1). NTIS, PC A02/MF A01;1; GPO Dep. Order Number DE88008894/JAW.

From 7. annual microcomputer information exchange conference; University Park, PA, USA (11 Mar 1988).

This paper discusses the use of IBM personal computers to do scientific calculations. (LSP)

42522 **(UCRL—98751) Notes on operating system requirements for the next millennium.** Watson, R.W. (Lawrence Livermore National Lab., CA (USA)). 13 May 1988. Contract W-7405-ENG-48. 7p. (CONF-8804136—1). NTIS, PC A02/MF A01;1; GPO Dep. Order Number DE88010712/JAW.

From Cray Users Group meeting; Minneapolis, MN, USA (26 Apr 1988).

The central characteristic of the operating system architectures of the future will be their focus on communication, modularity, explicit tasking based concurrency, and transparency of naming, protection, and error control. We believe these characteristics will be increasingly important to their user communities because they will allow support for easy addition of new services and accommodate new computing and communication architectures and capabilites. This paper discusses these operating systems. 14 refs.

42523 **Optimizing Givens' algorithm for multiprocessors.** Bernstein, H.J.; Goldstein, M. (Courant Institute of Mathematical Sciences, New York Univ., New York, NY (US)). *SIAM Journal on Scientific and Statistical Computing;* 9: No. 3, 601-602(May 1988).

Others have presented a version of Givens' bisection algorithm for the symmetric tridiagonal eigenvalue problem, addressed

to the case in which the number of eignevalues to be found is significantly more than the number of processors. The algorithm combines multisection and bisection, and uses a secant method to accelerate convergence. The authors compare it to an approach in which multisection is avoided and the acceleration is done by strict linear interpolation on an appropriate root of the magnitude of the determinant, and indicate why this earlier approach may be preferred in certain cases.

42524 **Modified cyclic algorithms for solving triangular systems on distributed-memory multiprocessors.** Eisenstat, S.C.; Heath, M.T.; Henkel, C.S.; Romine, C.H. (Dept. of Computer Science, Yale Univ., P.O. Box 2158 Yale Station, New Haven, CT (US)). *SIAM Journal on Scientific and Statistical Computing;* **9**: No. 3, 589-600(May 1988).

New parallel algorithms and comparative test results are given for solving triangular systems of linear equations on distributed-memory multiprocessors. These results supplement those given in a previous paper. All of the new algorithms are variations on the cyclic algorithms discussed previously. the new algorithms are shown to provide substantial performance improvements.

42525 **Parallel solution of triangular systems on distributed-memory multiprocessors.** Heath, M.T.; Romine, C.H. (Mathematical Sciences Section, Oak Ridge National Lab., P.O. Box Y, Oak Ridge, TN (US)). *SIAM Journal on Scientific and Statistical Computing;* **9**: No. 3, 558-588(May 1988).

Several parallel algorithms are presented for solving triangular systems of linear equations on distributed-memory multiprocessors. New wavefront algorithms are developed for both ros-oriented and column-oriented matrix storage. Performance of the new algorithms and several previously proposed algorithms is analyzed theoretically and illustrated empirically using implementations on commercially available hypercube multiprocessors.

42526 **A parallel triangular solver for a distributed-memory multiprocessor.** Li, G.; Coleman, T.F. (Jilin Univ. (CN)). *SIAM Journal on Scientific and Statistical Computing;* **9**: No. 3, 485-502(May 1988).

The authors consider solving triangular systems of linear equations on a distributed-memory multiprocessor which allows for a ring embedding. Specifically, the authors propose a parallel algorithm, applicable when the triangular matrix is distributed by column in a wrap fashion. Numerical experiments indicate that the new algorithm is very efficient in some circumstances (in particular, when the size of the problem is sufficiently large relative to the number of processors). A theoretical analysis confirms that the total running time varies linearly, with respect to the matrix order, up to a threshold value of the matrix order, after which the dependence is quadratic. Moreover they show that total message traffic is essentially the minimum possible. Finally, the authors describe an analogous row-oriented algorithm.

42527 **Equivalent sparse matrix reordering by elimination tree rotations.** Liu, J.W.H. (Dept. of Computer Science, York Univ., North York, Ontario (CA)). *SIAM Journal on Scientific and Statistical Computing;* **9**: No. 3, 424-444(May 1988).

In this paper, the authors introduce a class of ill-preserving equivalent reorderings for sparse Cholesky factorization. This class is based on performing a special form of tree rotation on the elimination tree of the given sparse matrix. Some applications on the use of such elimination tree rotation are described: core storage reduction in a sparse out-of-core scheme, working storage reduction in the multifrontal method, and solution of a subset of unknowns. Some experimental results are also provided to demonstrate its effectiveness in some of these applications.

42528 **High voltage control and monitoring system for proportional chambers.** Saarloos, J.; Olson, S.; Carithers, W.; Haber, C.; Orme, C.; Siegrist, J. (Lawrence Berkeley Lab., Univ. of California, Berkeley, CA (US)). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* **35**: No. 1, 191-192(Feb 1988). (CONF-871006—).

From 34. nuclear science symposium and 19. nuclear power systems symposium; San Francisco, CA, USA (21 Oct 1987).

The authors built and operated a system for distributing high voltage to 2000 channels of proportional chambers in the gas calorimeters of CDF. The system consists of CAMAC-based controllers and distribution modules in the Rabbit hardware standard developed at Fermilab. Current monitoring to one nanoamp and remote disconnect are available on each channel.

42529 **Signal processing for an optical wide band data transmission system.** Nakamura, M.; Leskovar, B.; Turko, B.T. (Lawrence Berkeley Lab., Univ. of California, Berkeley, CA (US)). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* **35**: No. 1, 197-204(Feb 1988). (CONF-871006—).

From 34. nuclear science symposium and 19. nuclear power systems symposium; San Francisco, CA, USA (21 Oct 1987).

The signal processing for an optical wide band transmission system using gallium arsenide (GaAs) digital integrated circuits and optical fibers has been investigated. Multiplexing, coding, synchronization, demultiplexing, and error checking at 780 Mbits/ data rates are described. Data storage in memory for linking to a computer is also considered. The design uses available GaAs and silicon components. The reliability of GaAs components is discussed as well as the layout and thermal considerations required for a high speed system.

42530 **Approximate parallel scheduling: Part I: The basic technique with applications to optimal parallel list ranking in logarithmic time.** Cole, R.; Vishkin, U. (Courant Institute of Mathematical Sciences, New York Univ., New York, NY (US)). *SIAM Journal on Computing;* **17**: No. 1, 128-142(Feb 1988).

The authors define a novel scheduling problem; it is solved in parallel by repeated, rapid, approximate reschedulings. This leads to the first optimal logarithmic time PRAM algorithm for list ranking. Companion papers show how to apply these results to obtain improved PRAM upper bounds for a variety of problems on graphs, including the following: connectivity, biconnectivity, Euler tour and st-numbering, and a number of problems on trees.

42531 **An integral manifold approach to reduced order dynamic modeling of synchronous machines.** Sauer, P.W.; Ahmed-Zaid, S.; Kokotovic, P.V. (Dept. of Electrical and Computer Engineering and The Coordinated Science Lab., Univ. of Illinois at Urbana-Champaign, Urbana, IL (US)). *IEEE Transactions on Power Systems;* **3**: No. 1, 17-23(Feb 1988).

The concept of integral manifolds is used to systematically create improved reduced order models of synchronous machines. The approach is illustrated through a detailed example of a single machine connected to an infinite bus. The example shows the advantages of the manifold approach and also clarifies several issues about reduced order models of synchronous machines. The basic objective of the method is to include the effects of more complex models without actually including the additional differential equations. This is illustrated by including the effects of stator transients and damper windings on the swing equation without including the differential equations.

42532 **Impact of hierarchical memory systems on linear algebra algorithm design.** Gallivan, K.; Jalby, W.; Meier, U.; Sameh, A.H. (Univ. of Illinois at Urbana-Champaign, Urbana, IL (US)). *International Journal of Supercomputer Application;* **2**: No. 1, 12-48(1988).

Linear algebra algorithms based on the BLAS or extended BLAS do not achieve high performance on multivector processors with a hierarchical memory system because of a lack of data locality. For such machines, block linear algebra algorithms must be implemented in terms of matrix-matrix primitives (BLAS3). Designing efficient linear algebra algorithms for these architectures requires analysis of the behavior of the matrix-matrix primitives and the resulting block algorithms as a function of certain system parameters. The analysis must identify the limits of performance improvement possible via blocking and any contradictory trends that require trade-off consideration. The authors propose a methodology that facilitates such an analysis and use it to analyze the performance of

the BLAS3 primitives used in block methods. A similar analysis of the block size-performance relationship is also performed at the algorithm level for block versions of the LU decomposition and the Gram-Schmidt orthogonalization procedures.

42533 **Modeling and generating input processes.** Johnson, M.E. (Statistics Group, MS F600, Los Alamos National Lab., Los Alamos, NM (US)). pp 30-32 of Proceedings of the 1987 winter simulation conference. Thesen, A.; Grant, H.; Kelton, W.D. San Diego, CA; Society for Computer Simulation (1988). (CONF-871216—).

From Winter simulation conference; Atlanta, GA, USA (14 Dec 1987).

This tutorial paper provides information relevant to the selection and generation of stochastic inputs to simulation studies. The primary area considered is multivariate but much of the philosophy at least is relevant to univariate inputs as well.

42534 **Generalized zero-variance solutions and intelligent random numbers.** Booth, T.E. (Los Alamos National Lab., Los Alamos, NM (US)). pp 445-454 of Proceedings of the 1987 winter simulation conference. Thesen, A.; Grant, H.; Kelton, W.D. San Diego, CA; Society for Computer Simulation (1988). (CONF-871216—).

From Winter simulation conference; Atlanta, GA, USA (14 Dec 1987).

It is shown that a zero-variance solution exists for any linear Monte Carlo problem and that this solution can be obtained by sampling the random numbers proportional to the expected score subsequently produced by using these random numbers in the random walk.

9903 Information Handling

REFER ALSO TO CITATION(S) 39633, 39707, 39993, 40016, 40028, 40031, 41198, 41397, 41487, 41495, 42459, 42462, 42464, 42472, 42473, 42479, 42507, 42509, 42520, 42530

42535 **(AD-A—190956/3/XAB) UNIX based programming tools for locally distributed network applications. Master's thesis.** Frank, W.C. (Naval Postgraduate School, Monterey, CA (USA)). Dec 1987. 105p. NTIS, PC A06/MF A01.

The Graphics and Video Laboratory of the Department of Computer Science has a growing need for easy-to-use programming tools in support of distributed-processing applications. The most pressing need is for software on three UNIX-based workstations connected via Ethernet. The remote interprocess communication tools that UNIX provides for using Ethernet are effective but complicated to learn. This requires researchers to spend much of their time becoming proficient with them instead of concentrating on the distributed application at hand. This work presents the design and implementation of several programming tools that allow programmers to establish and experiment with distributed programs in the graphics laboratory environment. The tools allow a higher level of abstraction for remote interprocess communications and establish a straightforward method for implementing distributed programs. Additionally, they support code reuseability with software templates and are modularized to be both understandable and changeable. Recommendations are made for future research and management efforts that have been highlighted by these new tools.

42536 **(AD-A—191577/6/XAB) Narrative-compression coding for a channel with errors. Professional paper for period ending June 1987.** Bond, J.W. (Naval Ocean Systems Center, San Diego, CA (USA)). Jan 1988. 17p. NTIS, PC A03/MF A01.

Data-compression codes offer the possibility of improving the thruput of existing communication systems in the near term. This study was undertaken to determine if data-compression codes could be utilized to provide message compression in a channel with up to a 0.10-bit error rate. The data-compression capabilities of codes were investigated by estimating the average number of bits-per-character required to transmit narrative files. The performance of the codes in a channel with errors (a noisy channel) was investigated in terms of the average numbers of characters-decoded-in-error and of characters-printed-in-error-per-bit-error. Results were obtained by encoding four narrative files, which were resident on an IBM-PC and use a 58-character set. The study focused on Huffman codes and suffix/prefix comma-free codes. Other data-compression codes, in particular, block codes and some simple variants of block codes, are briefly discussed to place the study results in context. Comma-free codes were found to have the most-promising data compression because error propagation due to bit errors are limited to a few characters for these codes. A technique was found to identify a suffix/prefix comma-free code giving nearly the same data compressions as a Huffman code with much less error propagation than the Huffman codes. Greater data compression can be achieved through the use of this comma-free code word assignments based on conditioned probabilities of character occurrence.

42537 **(AD-A—192089/1/XAB) Tracking the use of Ada in commercial applications; case studies and summary report. Revision.** Dikel, D. (IIT Research Inst., Chicago, IL (USA)). 9 Jan 1988. 34p. NTIS, PC A03/MF A01.

Four case studies were conducted in support of an Ada Joint Program Office (AJPO) effort to assist key managers in the evaluation of Ada's appropriateness as a technology for developing management information systems (MIS). This report describes the allocations studied as well as some of the dynamics involved with their development. The report seeks to qualitatively describe the costs, risks, and benefits present in these applications. The descriptive method provides sufficient detail for the manager to better relate the studies to his or her own situation and experience. The research builds on a comprehensive independent study to develop accurate methods of quantifying the costs, benefits, and risks of an Ada project. Even though this comprehensive study was based on non-MIS applications, the case-study questions were designed to test the correlation of their conclusions with the results. Applications were selected that would contribute important areas of understanding to the consideration of Ada for MIS. One case study was a complete branch banking system, including data base, office automation, and communications software. Another, a relational data base system complete with application generator and related tools, gave insights into portability, reliability, and maintainability issues. A third imposed the performance, reliability, and failure recovery requirements of a financial transaction system. The fourth integrated off-the-shelf components into reusable Ada subsystems.

42538 **(DOE/CE/30833—T1) Development of a document tracking system for renewable energy R and D reports: Status report.** (Chen (W.T.) and Co., Inc., Acton, MA (USA)). [1986]. Contract AC01-84CE30833. 200p. NTIS, PC A09;3. Order Number DE88007518/JAW.

The development of a Document Tracking System (DTS) for the office of Solar Heat Technologies is reported. In this report, the authors present a simple, low cost, decentralized system based upon six elements: (1) uniform letter of instruction, (2) report prefaces describing the background and context of the research, (3) subprogram description, (4) enclosed lists of reviewers and targeted readers, (5) standard form showing the project status, and (6) a standard form showing compliance with the reporting requirements. Each of these elements is described in the report, and example forms are provided for elucidation. The report concludes that by implementing the dissemination system described here, 1 million end users could be added to the present audience. (JDH)

42539 **(DOE/DP/70033—2) Research and development of models and instruments to define, measure, and improve shared information processing within government oversight agencies: Volume 1, Research status: 2nd Annual performance report, August 1986-July 1988.** Kurstedt, H.A. Jr. (Virginia Polytechnic Inst. and State Univ., Blacksburg (USA). Management Systems Labs.). 1988. Contract FG05-86DP70033. 80p. NTIS, PC A05/MF A01;1; GPO Dep. Order Number DE88009201/JAW.

More than ever before, government managers must effectively and efficiently direct and coordinate the sharing of data, information, and the complex of people and machines that create it, store it, retrieve it, manipulate it, and convert it into actions to move the country's business decisively forward. Driving this need

to share is a stunning technological capacity for automated processing, a deep-rooted desire to share born from a perception seemingly limitless possibilities, and a fiscal requirement to do better with less by making more out of what we have. Unfortunately, the shared information processing benefits Government Oversight Agencies (GOA's) need are not available just for the asking or for the cost of the equipment. This frustrates the manager who thinks the box on the desk should help with decision support as well as it helps with task automation. To move GOA's toward successful shared information processing and decision mechanisms, Management Systems Laboratories (MSL), under the grant, plans to accomplish the following two-part objectives: To use the real-world laboratory of the US Department of Energy (DOE) Office of Nuclear Materials (ONM) as a generic test to observe, define, characterize, and qualitatively model the shared information processing in a GOA; and then To develop qualitative and quantitative instruments to measure, evaluate and promote the psychological, sociological, and technological dimensions of successful sharing.

42540 **(ORNL—6464) Candidate evaluation system: Documentation of the data base design and application software for the prototype expert support system.** Arnold, H.G.; Loffman, R.S.; Sexton, F.L.; Rush, R.M. (Oak Ridge National Lab., TN (USA)). Jun 1988. Contract AC05-84OR21400. 706p. NTIS, PC A99/MF A01; 1; GPO Dep. Order Number DE88013334/JAW.

The US Department of the Army established the Candidate Evaluation Prototype Project, Project Management Office to analyze the current procedure for filing Army civilian jobs and to develop improved automated procedures to meet this need. The Army Civilian Personnel Center (now the Civilian Information Directorate) tasked The Oak Ridge National Laboratory (ORNL) to provide technical support, research, and development to the Project Management Office and deliver a prototype of a Candidate Evaluation System that would run on the minicomputer hardware and software being delivered to personnel offices located throughout the world. This report discusses the background of the project, including constraints and requirements; describes the data base design and program code developed to implement the prototype; documents known limitations of the prototype; and contains recommendations to be considered in future development. The objective of this report is to document the prototype software system for use by Army programmers/analysts who will maintain or further develop the prototype software.

42541 **(UCRL—21057) Rockwell NAAO technical order transfer tests.** (Lawrence Livermore National Lab., CA (USA); SYSCON Corp., San Diego, CA (USA)). 12 Jun 1987. Contract W-7405-ENG-48. 9p. (AITI—87-004). NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88012231/JAW.

The AFLC/AITI Standards Project is testing the Military Standard for the Automated Interchange of Technical Information, MIL-STD-1840 (the Standard). The objective of the tests is to demonstrate the validity of the transfer protocol defined in the Standard itself and the viability of standardized formats for the transfer of technical information defined in other specifications used by the Standard. The text files could not be processed due to difficulties with the file names in the tape header records that labeled the files. It appears, from conversations after the test, that the errors were generally a result of unfamiliarity with new methods of file set preparation.

9904 Law

42542 (EUR—11019, pp 261-271) **European communities policy in nuclear safety and sanitary protection after the Chernobylsk accident.** Finzi, S. (Commission of the European Communities, Brussels (Belgium)). 1987. (In French). NTIS (US Sales Only), PC A13/MF A01. Order Number DE88780090/JAW. (CONF-8611215—).

From Seminar concerning safety studies on severe accident in light water reactors; Brussels, Belgium (10 Nov 1986).

42543 (EUR—11019, pp 273-279) **U.S. appraisals and action on severe accident risk.** Bernero, R.M. (Nuclear Regulatory Commission, Washington, DC (US)). 1987. NTIS (US Sales Only), PC A13/MF A01. Order Number DE88780090/JAW. (CONF-8611215—).

From Seminar concerning safety studies on severe accident in light water reactors; Brussels, Belgium (10 Nov 1986).

This paper traces the history and development of U.S. appraisals of severe accident risk. The elements and basis of the U.S. Severe Accident Policy and Implementation Program are laid out. Requirements of new reactor applications and existing plant assessments are described. Regulatory changes in process or soon to come are described.

9905 Civilian Defense

REFER ALSO TO CITATION(S) 39994, 40099

42544 **(AD-A—191745/9/XAB) NATO acquisition strategy: a way to improve readiness and sustainability.** Fabrie, R. (National Defense Univ., Washington, DC (USA). Mobilization Concepts Development Center). Jan 1988. 13p. NTIS, PC A03/MF A01.

In the late 1970s, defense chiefs of the North Atlantic Treaty Organization (NATO) became troubled by the shifting balance in conventional-defense capabilities. While the Warsaw Pact has held a quantitative advantage in conventional forces, NATO's qualitative edge, coupled with a flexible response strategy of nuclear escalation, provided the Alliance with a credible deterrent against Warsaw Pact aggression. Strong conventional forces above those needed to conduct a brief forward defense were considered both unnecessary and politically not affordable. Developments in Warsaw Pact strategy and conventional-defense capabilities crystallized the need to strengthen the conventional component of NATO's military deterrence. The continuing Warsaw Pact military buildup in both numbers and quality of conventional and nuclear weapons, matched by NATO's failure to make sufficient responsive investments, had put the Alliance's strategy of deterrence and flexible response in jeopardy. More important, a sustained conventional attack without the use of nuclear weapons was becoming a major element in Soviet strategy.

42545 **(AD-A—191982/8/XAB) Geometry of a satellite-ballistic misile engagement. Interim report.** Miller, M.D. (RAND Corp., Santa Monica, CA (USA)). Feb 1988. 25p. (RAND/N—2093-SDIO). NTIS, PC A03/MF A01.

This note describes in mathematical terms the dynamic geometry between a constellation of satellites deployed for ballistic missile defense (BMD) and the missiles the satellites are engaging. Formulas, readily translatable into computer code, are given for such engagement parameters as slant range, closing velocity, and line-of-sight incidence angle in terms of satellite and missile position and velocity data. These formulas are the foundation of a model developed at RAND to support study of the BMD capability of various satellite armament concepts.